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[OFFICIAL NOTICE.]

Twenty-ninth Annual Meeting, Western Gas Association.

WESTERN GAS ASSOCIATION,
OFFICE OF THE SECRETARY,
NEW ALBANY, IND., March 22d, 1906.

To the Members of the Western Gas Association: The Twenty-ninth annual meeting of the Western Gas Association will be held in the Hollenden House, Cleveland, O., May 16, 17 and 18, and will be called to order at 10 A.M., by the President, Mr. Paul Doty, of St. Paul, Minn.

The Hollenden is prepared to accommodate 300 guests and furnish a room suitable for the sessions of the Association and announces the following rates: European plan—Rooms with running water, $1.50 and $2; rooms with bath, $2.50, $3, $3.50 and $4; double-bedded rooms with bath, $4 to $5.

The Hollenden, while conducted on the European plan, furnishes meals as follows: Club breakfast, 50 cents and upwards; an 8-course lunch for 50, 60 and 75 cents; table d'hote dinner, 65 cents.

Insomuch as more satisfactory arrangements can be obtained by securing rooms in advance of the meeting, members are requested to do so. The following papers will be presented to the Association, together with the names of those who are to prepare discussions on the same:

"Firing of Retort Benches by Battery Producers," by Mr. Fred. Bredel, Milwaukee, Wis. Discussions prepared by Messrs. W. A. Baehr, H. B. Harrop and H. A. Carpenter.

"Electrolysis of Gas Mains," by Mr. M. R. Bump, Denver, Col. Discussions prepared by Messrs. J. D. von Maur, Bryce McAdam and C. L. Day.

"The Relation of Gas to Our Modern Life," by Mrs. O. N. Guldlin, Fort Wayne, Ind. Discussions prepared by Messrs. J. B. Howard, J. C. D. Clarke and Irvin Butterworth.

"General Data on Artificial Gas Properties," by Mr. W. E. Steinwedell, Cleveland, O. Discussions prepared by Messrs. E. G. Cowdery, James T. Lynn and Edwin E. Witherby.

"Notes on Carbonization," by Mr. W. E. Hartman, Joliet, Ills. Discussions prepared by Messrs. O. O. Thwing, John R. Lynn and M. E. Malone.

"Regulation of Rates," by Mr. Geo. McLean, Dubuque, Ia. Discussions prepared by Messrs. M. S. Greenough, Henry L. Doherty and I. C. Copley.

"Change in Grade of Mains at Galveston," by Mr. John Gimper, Galveston, Tex. Discussions prepared by Messrs. J. H. Eustace, T. D. Miller and F. H. Shelton.

"Labor Saving Machinery for Medium Sized Retort Houses," by Mr. F. H. Shelton, Philadelphia, Pa. Discussions prepared by Messrs. Carl H. Graf, R. P. Kraft and B. O. Tippy.

"The Making of Rates and the Additional Business System of Cost," by Mr. W. H. Gardiner, Jr., Boston, Mass. Discussions prepared by Messrs. E. G. Pratt, S. J. Glass, A. P. Lathrop and H. L. Doherty.

"Some Brief Notes on Capacities of Water Gas Sets," by Mr. Rollin Norris, Philadelphia, Pa. Discussions prepared by Messrs. D. McDonald, R. E. Slade, A. F. Travis and B. E. Chollar.

"A Balance between Calorific Value and Candle Power in Water Gas," by Mr. T. D. Miller, New Orleans, La. Discussions prepared by Messrs. E. Y. Sayer, J. D. Shattuck and G. W. McKee.

"The Utilization of Tar in a Water Gas Apparatus," by Mr. Geo. H. Waring, Omaha, Neb. Discussions prepared by Messrs. W. B. Calkins, Geo. S. Clarke, V. E. Dewey and Leonard Fitzgerald.

"Water Gas Practice," by Mr. D. G. Fisher, St. Louis, Mo. Discussions prepared by Messrs. W. H. Barthold, C. H. Evans and E. E. Eysenbach.

"Extraction of Tar from Water Gas," by Mr. E. H. Earnshaw, Cincinnati, O. Discussions prepared by Messrs. H. C. Abell, H. H. Scott, R. B. Brown and V. L. Elbert.

"The Mutual Advantage to be Derived through Co-operation between Engineering Schools and Those Engaged in the Gas Business," by Prof. Chas. F. Burgess, University of Wisconsin. Discussions prepared by Messrs. A. E. Forstall, Geo. G. Ramsdell and Dr. H. B. Harrop.

"The Relations between Gas Companies and their Employees," by Mr. Joseph M. Berkley, Los Angeles, Cal. Discussions prepared by Messrs. Emerson McMillin, G. W. Clabaugh and R. M. Searle.

"Wrinkle Department," Edited by Mr. Bryce McAdam, Milwaukee, Wis. Discussions prepared by Messrs. B. W. Perkins, V. L. Elbert, Albert Kersting, S. O. Fulkerson, Chas. Forbes and James Ferrier.

"A Lecture on Industrial Betterment," by Dr. Wm. H. Tolman, New York.

"A Lecture on Engineering of Illumination," by Mr. Van Rensselaer Lansingh, New York.

It must not be inferred that discussions of papers will be limited to those whose names appear as above, for copies of all papers will be sent members in advance of the meeting, with the request that each

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come prepared to add to the general fund of information. And it is hoped that each member will consider it a duty to do so.

Papers will not be read in their entirety, but 5 minutes will be allowed each author of a paper to present conclusions.

The following passenger associations have granted reduced rates on the certificate plan, of 1½ fare for the round trip, conditional on 100 railroad certificates being presented for indorsement: Central Passenger Association, Trunk Line Association, New England Passenger Association—excepting steamship lines—Southeastern Passenger Association, Southwestern Passenger Association and Western Passenger Association.

The territories embraced by the above Associations are all the States and territories in the United States east of the line of longitude that passes through Cheyenne, Wyoming, and Denver, Col., excepting the State of Ohio, where the railroad companies are charging a uniform rate of 2 cents per mile. Those who purchase tickets to Cleveland from the State of Ohio will please obtain from ticket agent a receipt for their ticket, which receipt should be handed the Secretary of the Association and will count the same as a certificate in securing the desired 100 necessary to secure the reduced rates.

Apply to the ticket agent at least 30 minutes before the departure of trains, purchase a first-class ticket to Cleveland, paying full fare for the same, receiving from the agent certificate stating that a ticket has been purchased to attend the Western Gas Association meeting in Cleveland. This certificate must be handed the Secretary of the Association, who will have the proper indorsement made by the Passenger Association representative, which, upon the payment of 25 cents to the Passenger Association representative, will entitle the holder to a one-third rate returning home. Members are especially requested not to use their mileage books, and members from Ohio to secure receipts for the purchase of their tickets, inasmuch as the larger number of certificates and receipts obtained will make it easier for the Association in the future to obtain concessions from the various Passenger Associations.

Mr. M. S. Greenough, President of the Committee of Arrangements, announces the following entertainment programme for the Western meeting:

Ladies—Wednesday evening: Illustrated lecture at the Hollenden assembly room, followed by refreshments. Thursday, A.M.: Automobile ride through parks and boulevards; tea at Euclid Club. Thursday, P.M.: Theater party.

Gentlemen—Wednesday, P.M.: Illustrated lecture at the Hollenden assembly room, followed by refreshments. Thursday, P.M.: Banquet at the Hollenden. Friday: Visit to the gas works. Tickets to the banquet, $5.

The meeting of the Board of Directors will be held at the Hollenden House, Tuesday, May 16th, at 10 A.M.

The Secretary will be pleased to furnish application blanks to those wishing to become members of the Association.

A cordial invitation is extended to members of kindred Associations to be present and take part in the discussion of papers presented.

JAS. W. DUNBAR, Secretary.

BRIEFLY TOLD.

"THE LAKE SHORE AND CHICAGO SPECIAL."—From sources that may not be denied it is a fact that Mr. George D. Roper, of Rockford, Ills., has been named as "Master of Transportation" for the coming meeting of the Western Gas Association, as between Chicago and Cleveland. Mr. Roper has arranged with the Lake Shore Road to have "A train equal to, if not better, than the 'Twentieth Century Limited,'" which special will leave Chicago at 10:30 A.M. of May 15th, the schedule calling for its arrival in Cleveland prior to 6 P.M. of the same day, which should be exceedingly convenient for those who will go to the twenty-ninth meeting of the Western Gas Association on the line named. Mr. Roper will be pleased to furnish any information desired in this respect.

NOTES.—

MR. WILLIAM H. HOPPER died in Germantown, Pa., the morning of April 11th. He was a son of the late Mr. Thomas C. Hopper, who for years had a large interest in the American Meter Company, and the deceased was also prominent in its doings. He was in his 54th year, and is survived by his wife, a son and a daughter. He retired from active business in 1899.

THE Gas Machinery Company, of Cleveland, O., has been awarded a contract for the construction of a 4-foot double superheater water gas apparatus for the Charlestown (W. Va.) Gas and Water Company.

[OFFICIAL REPORT—CONTINUED FROM PAGE 712.]

TWENTY-SECOND ANNUAL MEETING, OHIO GAS LIGHT ASSOCIATION.

HELD IN CINCINNATI, O., MARCH 21, 22 AND 23, 1906.

FIRST DAY—MORNING SESSION.

The President introduced Mr. Henry I. Lea, who read the following paper on

THE PROSPECTIVE COMPETITION OF PRODUCER GAS WITH OTHER COMMERCIAL GASES.

In the hubbubs attending the opening of any field of great commercial importance, there invariably appear many statements embodying more of novelty than of truth. To this seeming law the producer gas field is no exception, and because exaggeration often beclouds the significance of warranted claims this attem t is made to show some of the lines along which producer gas practice does properly demand the consideration of existing gas companies.

Of all known gas processes, those involved in the manufacture of producer gas have, as a class, the highest thermal efficiency. Under closely adjusted condition, a thermal efficiency as high as 85 per cent. has been obtained by the writer in practice, and many builders will guarantee 75 per cent. under normal operating conditions, even when the gas is used cold. This high thermal efficiency is the base on which producer gas finds its footing, for it allows even a small producer gas engine plant to run on approximately 1 pound of coal per brake horse power hour.

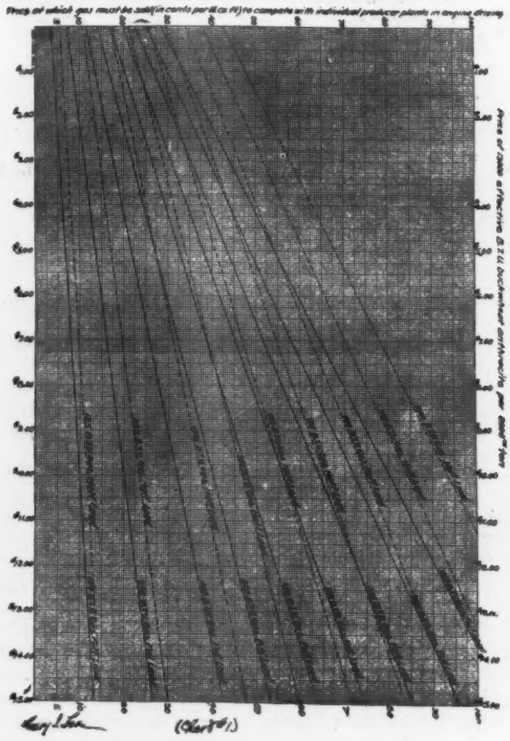
Modern gas engines of medium size can be operated on less than 11,000 B. T. U. per brake horse power hour, and producer engine outfits can be bought under guarantee to deliver one on a consumption of less than 1½ pounds of 13,000 B. T. U. coal. Comparing this with steam practice, we find that in the largest, best equipped and best managed of modern steam plants ashore, a boiler consumption as low as 2½ pounds of coal per B. H. P. hour is considered very efficient working. The great majority of fairly well managed steam plants require over 4 pounds, while many plants require as high as 10 or even 12 pounds of coal under boilers per B. H. P. hour developed by the engines.

Government statistics show about 6 pounds as the average of all the plants listed. From the above we gather a general idea of the relative fuel economies of steam boiler as against gas producer plants for engine driving; but this paper is concerned more particularly with the application of producer gas in fields at present occupied by such gas companies as are represented in this Association.

All of our larger gas companies, and many of the smaller ones, have recognized the importance of gas engines as consumers. In the hope that they might be of interest, the writer has prepared charts showing the price at which city gas must be sold to meet the competition of the individual producer plant. Let us assume, for instance, that a power user wishes to know whether a producer installation would afford power at lower cost than would city gas. Inasmuch as the producer gas engine would cost about the same as the city gas engine (the only important difference being the cylinder diameter, which is greater on the producer gas engine because of its lower M. E. P.), it will be fair to ignore the cost of the engine itself and to base our calculations upon the cost and thermal value of the city gas as against the cost and thermal value of producer gas, including in this latter cost the interest upon producer investment, taxes and depreciation on producer and the labor involved in a producer plant above that required by the engine when running on city gas.

Let us assume that the engine in question is to be of 25 B. H. P., that the producer apparatus complete will cost $1,000, and that the producer will require 2 hours of labor per day. Reckoning labor at 17½ cents per hour, interest, depreciation and taxes together on producer plant at 15 per cent., allowing 12,000 effective B. T. U.'s on full-load and 16,000 B. T. U.'s on half-load as the engine requirement per B. H. P. hour, we find, by referring to Chart No. 1, that if a 13,000 effective B. T. U. buckwheat anthracite coal can be bought in this town for $5 per 2,000 pound ton delivered, that a 600 B. T. U. gas must be sold at the rate of 32½ cents per 1,000 cubic feet in order to meet the competition of the individual producer plant when the engine carries full load 10 hours per day and 300 days per year.

It is very seldom, however, that engines of this size operate continuously on full load, and since a lower load factor would enable the city gas to demand a higher price, figures have also been prepared to meet this condition.



Assumptions.
- Capacity of engine—25 B. H. P.
- Engine operating 10 hours per day, 300 days per year.
- Producer to cost, complete, $1,000 and to require 2 hours (at 17½ cents) labor per day.
- Interest, depreciation and taxes on producer — 15 per cent.
- Engine to require 12,000 effective B.T.U. on full load and 16,000 B.T.U. on half load per B. H. P. hour.

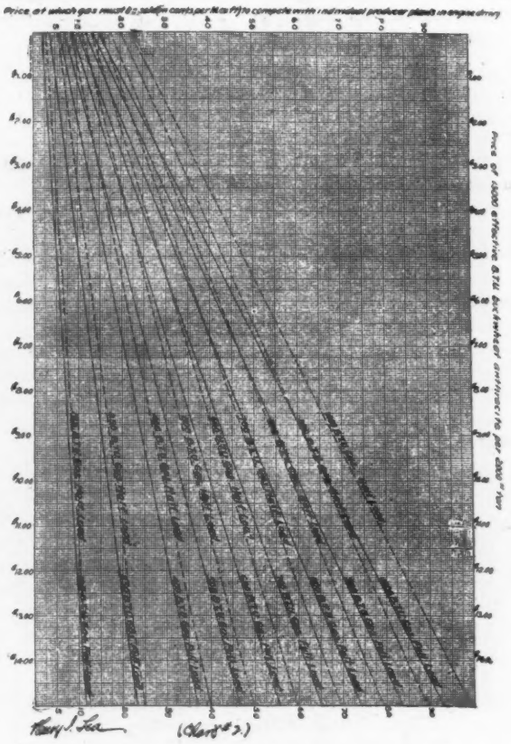
Referring to Chart No. 1, we find that when engine has 50 per cent load factor a 600 B.T.U. gas may be sold at 41 cents per 1,000 cubic feet and still meet the competition of the individual producer plant, with the other conditions as above outlined. This Chart No. 1 shows practically the entire range throughout which a 25-horse power producer plant can compete with other commercial gases.

In Pittsburgh, for instance, where we have a natural gas of practically 1,000 effective B.T.U.'s per cubic foot, and where 13,000 B.T.U. anthracite coal costs $3.50 per ton delivered in carloads, it is seen that with this engine operating with 50 per cent. load factor, this natural gas might be sold at 60½ cents per 1,000 cubic feet and still meet the competition of the individual 25-horse power producer plant. As a matter of fact, this very gas is sold in Pittsburgh usually at 25 cents per 1,000 cubic feet, and in some cases lower than this. As a consequence, an individual producer plant of this size has no show at all in competition with the natural gas of Pittsburgh for engine driving. The conditions in Pittsburgh, however, are strikingly bad from the producer standpoint, for the natural gas is of exceptionally high thermal value and its price is unusually low. Even with these advantages, natural gas proves more expensive than steam for engine driving in many cases. Those cases are not taken up in this paper, its function being to show only the relative value of the gases commercially used.

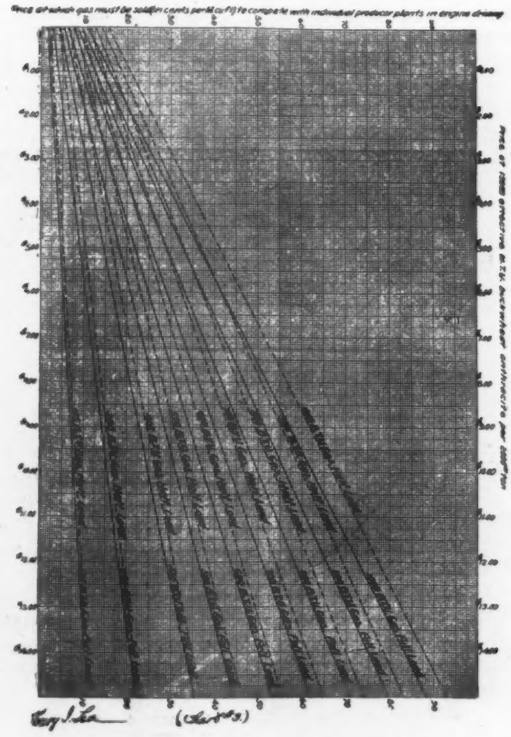
On considering a natural gas of 800 effective B.T.U.'s per cubic foot, we find, by referring to Chart No. 1, that if this gas is sold at more than 37½ cents per 1,000 cubic feet it cannot meet the competition of the individual 25-horse power producer plant when 13,000 B.T.U. coal costs $3.50 per ton and the engine carries full load. Chart No. 1 also shows that, under the other conditions given, a 600 B.T.U. gas sold at 50 cents per 1,000 cubic feet will only meet the competition of the individual 25-horse power producer plant when the producer coal costs $8 per ton and the engine is running on half-load, or when the coal costs $10.50 per ton with the engine carrying full load.

From Chart No. 1 we gather also that in a town in which this coal may be bought for $2 per ton (other conditions being as specified, with the engine carrying full load in each case) the several gases listed will have the following values in the driving of a 25-horse power engine:

1,000	effective B.T.U. gas	38.75	cents	per	1,000	cubic	feet.
900	" "	34.87	"	"	"	"	"
800	" "	31.00	"	"	"	"	"
700	" "	27.12	"	"	"	"	"
600	" "	23.25	"	"	"	"	"



Assumptions.
- Capacity of engine—100 B. H. P.
- Engine operating 10 hours per day, 300 days per year.
- Producer to cost, complete, $2,500 and to require 3 hours (at 17½ cents) labor per day.
- Interest, depreciation and taxes on producer — 15 per cent.
- Engine to require 12,000 effective B.T.U. on full load and 16,000 B.T.U. on half load per B. H. P. hour.



Assumptions.
- Capacity of engine—500 B. H. P.
- Engine operating 10 hours per day, 300 days per year.
- Producer to cost, complete, $9,000 and to require 10 hours (at 17½ cents) labor per day.
- Interest, depreciation and taxes on producer — 15 per cent.
- Engine to require 12,000 effective B.T.U. on full load and 16,000 B.T.U. on half load per B. H. P. hour.

500	effective B.T.U. gas	19.37	cents	per	1,000	cubic	feet.
400	" "	15.5	"	"	"	"	"
250	" "	9.68	"	"	"	"	"
125	" "	4.84	"	"	"	"	"

With this same coal costing $8 per ton, and other conditions all as given for preceding figures, the following values obtain:

1,000 effective B.T.U. gas				70.00	cents	per	1,000	cubic feet.
900	"	"	"	63.00	"	"	"	"
800	"	"	"	56.00	"	"	"	"
700	"	"	"	49.00	"	"	"	"
600	"	"	"	42.40	"	"	"	"
500	"	"	"	35.00	"	"	"	"
400	"	"	"	28.00	"	"	"	"
250	"	"	"	17.5	"	"	"	"
125	"	"	"	8.75	"	"	"	"

Obviously, the size of the plant itself has an important bearing in this matter of competition, the fixed charges per horse power capacity decreasing as the size of plant increases, while the producer coal consumption per horse power hour remains practically the same. For this reason a gas company will find it more difficult to comgete with a 100-horse power producer plant than it will with one of 25-horse power.

On Chart No. 2 may be found prices at which other gases must be sold to meet the competition of the individual producer plant of 100-horse power capacity.

If we allow $2,500 as total cost of 100-horse power producer erected (and there are several plants that may be bought for considerably less than this), 3 hours' labor per day required by the producer and the other conditions as given in Chart No. 2, we find that 600 B.T.U. gas, in a town where 13,000 B.T.U. anthracite coal may be bought for $6 per 2,000-pound ton, must be sold at 27½ cents per 1,000 cubic feet to meet the competition of a 100-horse power producer plant when the engine carries full load 10 hours per day and 300 days per year. In all the figures given as to producer coal consumption per B. H. P. hour the standby losses are included.

Again, with a 100-horse power producer engine carrying full load, the other conditions being as specified on Chart No. 2, and with coal costs of $2, $8 and $12 per ton respectively, the following values obtain:

	Cents per 1,000 Cubic Feet— Producer Coal Costing $2 Per Ton.	Producer Coal Costing $8 Per Ton.	Producer Coal Costing $12 Per Ton.
1,000 effective B.T.U. gas	25.20	56.4	77.2
900 " " "	22.68	50.8	69.5
800 " " "	20.16	45.1	61.8
700 " " "	17.6	39.5	54.1
600 " " "	15.13	33.8	46.3
500 " " "	12.6	28.2	38.6
400 " " "	10.08	22.5	30.9
250 " " "	6.3	14.1	19.3
125 " " "	3.15	7.05	9.66

A corresponding table for 500-horse power producer engine plant, with 100 per cent. load factor and other conditions is as specified on Chart No. 3:

	Cents per 1,000 Cubic Feet— Producer Coal Costing $2 Per Ton.	Producer Coal Costing $8 Per Ton.	Producer Coal Costing $12 Per Ton.
1,000 effective B.T.U. gas	20.83	52.08	72.91
900 " " "	18.75	46.87	65 62
800 " " "	16.6	41.66	58.33
700 " " "	14.57	36.45	51.0
600 " " "	12.5	31.25	43.75
500 " " "	10.41	26.04	36.45
400 " " "	8 33	20.8	28.16
250 " " "	5.20	13.02	18.22
125 " " "	2.6	6.51	9.11

The foregoing figures are based on producers using anthracite coal, because of its adaptability to small units. These same producers will also operate satisfactorily on coke and charcoal, although with a somewhat lower capacity per square foot of reducing surface. In this connection, the actual cost of anthracite producer gas on a large scale might be of interest.

The following data are therefore submitted as being actual results obtained in 6 months' operation of a 10,500-horse power producer installation, by a concern having no direct connection whatever with the development of producers. The anthracite used shows the following analysis:

Moisture	6.56
Volatile	8.49
Fixed carbon	69.51
Ash	15.44
B.T.U. per pound	11,036
Ash	17.16 per cent.
Carbon in ash	10.2 " "

The coal used under water tube boilers with good stokers evaporated 7.5 pounds water per pound of coal and 9.61 pounds water per pound of combustible.

Used in producers, this coal yielded 128,300 cubic feet (cold) of 136 B.T.U. gas, which gave the producer a thermal efficiency of 78 per cent. Expense of operation was as follows:

		Per 2,000-Pound Ton of Coal Gasified.	Per 1,000 Cubic Feet of 136 B.T.U. Gas.
Labor	Foreman $0.0473; Top men 0.1982; Bottom men 0.1678	$0.4133	$2.003211
Repairs	Labor 0.0410; Material 0.0464	0.0874	0.000681
Steam	Labor 0.0345; 200 lbs. coal 0.155	0.1895	0.001477
Cleaning gas (water, etc.)		.153	0.001192
Coal in producers		1.56	0.012159
Total operating charge		$2.4032	$0.018730

During the 6 months' run, 26,409 tons of coal were gasified, so the above figures may be taken as reliable averages. In addition to operating charges, we must allow, say, 15 per cent. on $150,000 to cover interest, depreciation and taxes on plant, buildings and real estate. Allowing also $5,000 per year to cover management and office expenses, we bring our costs up as follows:

	Per 2,000-Pound Ton of Coal Gasified.	Per 1,000 Cubic Feet of 136 B.T.U. Gas.
Total operating charges (say)	$2.41	$0.01875
Interest, dep. and taxes (15 pr. ct. on $150,000)	0.425	0.00332
Management and office ($5,000)	0.095	0.00074
Grand total	$2.930	$0.02281

At this total cost we have in gaseous form a thermal value fully equal to the gross value of this same 11,036 B.T.U. coal when its cost is $3.73 per 2,000-pound ton.

Generally speaking, it is very conservative to say that a gaseous fuel may be burned with an efficiency 20 per cent. higher than is obtained in burning solid fuels.

Therefore, for any heating operation to which it is adopted, this 136 B.T.U. gas, at 2.3 cents per 1,000 cubic feet, affords as cheap a fuel as does 11,036 B.T.U. coal at $4.47 per 2,000-pound ton, when the fuel is used directly, as in the ordinary stove or furnace. While the low flame temperature of anthracite producer gas leaves it totally unfit for many of the important metallurgical operations, there are few to which bituminous producer gas may not be successfully applied. The excellent work regularly done by bituminous producer gas in the enormous open hearth furnaces shows conclusively its importance to the steel industry, and that its field will be greatly extended there can be no reasonable doubt.

Although there is as yet no bituminous producer meeting all the present requirements, sufficient advancement has been made to warrant us in considering the possibilities of general distribution of producer gas,

Most of onr members doubtless recall a paper read by Mr. F.H. Shelton before the Western Gas Association, at Cincinnati in 1897, citing all the important attempts at fuel gas supply made in this country up to that date. The record, which covers 27 attempts throughout a range of 16 years, is one of failure after failure. From that able paper may be gathered the data as shown in table at top of page 753.

While many of these attempts were poorly handled from an engineering standpoint, there surely were some (notably those made by existing gas companies, as at Boston, St. Louis, Des Moines, Savannah and Louisville) that were made honestly and intelligently. Yet the greatest value regularly delivered for 1 cent, figuring the highest thermal value and the lowest price named in connection with the attempt, was 16,142 B. T. U.'s from the McKenzie oil process at Terre Haute, Ind. At Bridgeport, Conn., the record cites a few instances as high as 24,000 B. T. U.'s for 1 cent, although the usual value delivered was from 7,500 to 10,000. Now, other conditions being equal, the value of a gas to the public is, of course, in direct proportion to the B. T. U.'s delivered for 1 cent. At 650 B. T. U. gas sold at 50 cents per 1,000, delivers 13,000 B. T. U.'s per cent.

The 136 B. T. U. gas previously mentioned, costing the maker 2.3 cents, delivers 59,130 B. T. U.'s per cent. at the works.

If producer gas is to be generally distributed, even for services to which it is adapted as well as gases of higher thermal value per cubic foot, it is obvious that the value delivered per 1 cent must come somewhere between 13,000 and 59,130 B. T. U.'s.

There is to-day, at South Staffordshire, England, a large company delivering bituminous producer gas of 136 to 140 B. T. U. per cubic foot, at prices ranging from 4 cents to 8 cents per 1,000 cubic feet. In other words, from 17,000 to 35,000 B. T. U.'s are being delivered for 1 cent.

Year Tried.	Location.	Process.	Thermal Value of Gas in B. T. U.'s per Square Feet.	Price per 1,000 Cubic Feet.	Maximum B. T. U.'s Delivered per 1 cent.
1880....	Yonkers, N Y.....	Lowe and (later) Strong	310 to 365	$.50	7,300
1883....	Lynn, Mass.....	Lowe.....	280 to 300	$.50 to $.30	10,000
1886 ...	Troy, N. Y	"	280 to 300	.50	6,000
1887....	Bellevue, Ky.....	.....	300	.50	6,000
1888....	Tacony, Pa.....	Loomis.....	307	.50 to .30	10,233
1888....	Los Angeles, Cal.....	Lowe.....	300	.....	.....
1889....	Akron, O.....	Loomis.....	307 (?)	.50 to .30	10,233
1888....	Omaha, Neb.....	Lowe (Boecklen).....	300	.....	.....
1891....	Centerville, Ia.....	Loomis	307 (?)	.90 to .75	4,093
1889....	Terre Haute, Ind.....	McKenzie (oil).....	400 to 565	.35	16,142
1890....	Rapid City, S. D.....	Loomis.....	.....	.....	.....
1890....	Ottumwa, Ia.....	"	307 (?)	1.00	3,070
1887....	Jackson, Mich.....	Evans.....	400	1.00 to .30	13,333
1889....	Chicago, Ills.....	Fahnehjelm.....	325	.50	6,500
1890....	St. Joseph, Mo.....	"	325	.50	6,500
1889....	Cornwall, Ont.....	"	300	.....	.....
1889....	Fort Madison, Ia.....	"	300	.....	.....
1891....	Grand Rapids, Mich.....	Hall and (later) Kitson.....	150 to 160	.....	.....
1891....	Maysville, Ky.....	.....	150 to 160 (?)	.40	4,000
1890....	Boston, Mass.....	Loomis.....	400 (?)	.60	6,666
1890....	St. Louis, Mo.....	Lowe.....	300	.40 to .30	10,000
1891....	Des Moines, Ia.....	"	400 to 590	.50	11,800
1890....	Savannah, Ga.....	"	400 to 425	.90 to .50	8,500
1891....	Louisville, Ky.....	"	300	.50	6,000
1890....	Cottage City, Mass.....	Loomis.....	350 (?)	1.56	2,243
1891....	Framingham, Mass.....	"	350 (?)	.59 to .58	6,034
1894....	Bridgeport, Conn.....	"	300	.40 to .12½	7,500 to 24,000

To be sure, this company has not been in operation long enough to make very reliable statements as to distribution expenses, but it is evident that the margin existing between 13,000 B. T. U.'s in form of 650 B. T. U. gas delivered and 59,130 B. T. U.'s in form of 136 B. T. U. gas at the works, will cover distribution charges, under some conditions. Further, bituminous producer gas can, in many instances, be made at considerably lower cost than that here shown for anthracite gas. If now we grant that existing gas companies cannot regularly sell 650 B. T. U. manufactured gas for less than 50 cents, a 136 B. T. U. producer gas has a competing chance at 10 cents per 1,000 for the services to which it is adapted. This leaves us 10 — 2.3 = 7.7 cents per cubic feet with which to pay interest, depreciation and maintenance or distribution system. Since about 5 volumes of producer gas are required in replacing 1 volume of 650 B. T. U. gas, the distribution system will be considerably more expensive than required for the richer gas.

Holder capacity being too expensive for gases so lean, compression must be at once resorted to, the peak loads being cared for by reserve producers at the works. In the 10,500-horse power plant previously referred to, 6,776,549,000 cubic feet of gas were made per year.

This plant would, therefore, have 6,776,549 × 7.7 cents = $521,794, with which to pay operation charges, interest and depreciation on compressing plant and distribution system.

Assuming an ideal load factor, allowing plant to run continuously at full capacity, 18,566,000 cubic feet of gas would have to be compressed per day, to, say 5 pounds, as is being done in England. For such volumes, present styles of compressors are not nearly as well adapted as are the twin-tandem, horizontal gas engine driven, "blowing tubs" now used in blast furnace work. The compression plant would, therefore, involve:

Two 800-horse power producer engine compressors (1 spare)	$64,000
One 1,000-horse power producer (in addition to regular plant, say)	10,000
Building, foundations and incidentals	10,000

Allowing 1¼ pound coal per B.H.P. hour, and .8 B.H.P. as being required to compress 1,000 cubic feet of .8 gravity gas per hour to 5 pounds above atmosphere (this being a liberal allowance) we have a yearly coal consumption in this producer of 4,235 tons. The following is, therefore, the cost, per year, of compression:

15 per cent. (int., dep., taxes on extra building, foundations, etc.)	on $10,000 =	$1,500
15 per cent. (int., dep. and taxes on compressors	on 64,000 =	9,600
Operating compressors { labor $4,000 / material 500 }	=	4,500
4,235 tons coal gasified at $2.93 ($2.93 covers interest, etc., as before shown)	=	12,400
Total		$28,000

We, therefore, have:	Per 2,000-Pound Ton of Coal Gasified.	Per 1,000 Cubic Feet of 136 B.T.U. Gas.
Total manufacturing costs	$2.93	$.023
Total compressing costs	53	.004
Cost ready for distribution	$3.46	$.027

Deducting compression charges from sum available for total distribution expenses, we have $493,794 with which to cover expenses outside of works, under these ideal conditions.

But like most ideals this condition is entirely out of the question in the field at present most attractive to producer gas, viz.: Engine driving—for here the individual producer plant is the greatest enemy of the central producer plant. Coming down now from our ideal load factor to one of, say 33⅓ per cent., we have a condition that would probably be met in actual distribution of producer gas.

In other words, to provide for an average sendout of 10,500-horse power per hour, a station capacity of 31,500-horse power must be provided in generating and compressing ends. Further, since peak loads are to be carried by reserve producers and compressors, the men necessary must be almost constantly available.

With such an arrangement, the thermal efficiency of the producer plant proper would remain about as before, the fuel consumption per horse power hour of the compressing station would be increased by at least 25 per cent. and the labor and fixed charges by about 160 per cent.

Therefore, in a plant designed for city supply, the costs will run approximately as follows:

		Per 2,000-Pound Ton of Coal Gasified.	Per 1,000 Cubic Feet of 136 B.T.U. Gas.
Labor	{ foreman $.1419 / top men .5946 / bottom men .5034 }	$1.2399	$.009661
Repairs	{ labor .1230 / material .1392 }	.2622	.002043
Steam	{ labor .1035 / 400 pound coal .310 }	.4135	.003222
Cleaning gas		.459	.003576
Coal in producers		1.56	.011159
Int., dep. and taxes at 15 per cent. on $450,000 main plant		1.275	.00996
Management and office ($10,000)		.1893	.001475
Total manufacturing costs		$5.40	$.042

The following is probable cost of compression of 33⅓ per cent. load factor:

10 per cent. (int., dep. and taxes on extra buildings, foundations, etc)	on $20,000 =	$2,000
15 per cent. (int., dep. and taxes on 4 compressors)	on 128,000 =	19,200
Operating compressors { labor $9,000 / oil, etc 1,000 }	=	10,000
5,300 tons producer coal at $5.40 (gasified) ($5.40 covers interest, etc., as previously shown.)	=	28,600
Total		$59,800

Now, to find the cost of gas compressed:

	Per 2,000-Pound Ton of Coal Gasified.	Per 1,000 Cu. Ft. of 136 B.T.U. Gas.
Total manufacturing cost	$5.40 +	$0.042 +
Total compression cost	1.13 +	0.00882 +
Cost ready for distribution (say)	$6.53	$0.051

From the above cost the importance of load factor in producer gas

distribution is very apparent. The larger power users might better install their own producer plants than pay the rates made necessary by high and fixed charges on a central station with poor load factor.

Charts Nos. 1, 2 and 3 will show the points at which owners of 25, 100 and 500-horse power engines, respectively, would find it advantageous to buy 125 B.T.U. producer gas from a central station.

As against $6 coal in individual producer, the 25-horse power plant could pay 9.8 cents, the 100-horse power plant could pay 7.1 cents and the 500-horse power plant 6.25 cents per 1,000 cubic feet of 136 B.T.U. gas, when operating with 50 per cent. load factor in each case, and still get a power at as low a cost as an individual producer plant would afford. The equivalent selling prices of 600 B.T.U. gas would be, as per charts, 44 cents, 31¼ cents and 27¼ cents respectively.

It seems reasonable, therefore, to figure that an average price of 7.5 cents per 1,000 could be obtained for 136 B.T.U. gas in engine driving. A continuous output averaging 10,500-horse power per hour would, at this price, render available 6,776,549 (7.5 — 5.1 cents) = $162,637 per year with which to meet distribution and management expenses outside of plant. This would seem to warrant us in considering the other important services to which this lean gas is adapted. Lighting with producer gas has been tried in an experimental way, but as yet no mantle has been developed that will properly incandesce at the relatively low flame temperatures possible with producer gas.

The 136 B.T.U. anthracite gas mentioned throughout this paper is not adapted to temperatures much over 1,200° C., even when used in large quantities and where recuperation is permissible. A good bituminous producer gas, with recuperation, will maintain 1,500° or even 1,600° C. It does not, however, seem a very far cry to a combination of oxides that will work up into a satisfactory producer gas mantle. The burner itself must also be especially adapted to producer gas, but this point the writer knows can be met. For use in the cooking range, producer gas has not quite so far to go as it has in the lighting field.

Producer gas has been continuously and successfully used for cooking in a few isolated cases, as at the Walthamstow Hospital, England, where the cooking for 80 persons has been for the past 5 years regularly done with the same gas that is used for the engine driving, the hot water supply and the heating of buildings.

There again special burners are required, and because of sulphur content in gas, hoods are almost essential. A more important objection, however, lies in the fact that it will be practically impossible to build a producer gas range from which as quick action will be obtained as is obtained with the ranges now used on other commercial gases. For lighting and cooking, then, producer gas can point to but little in the way of achievement, although it has some claims and will doubtless make more or less advance along both these lines for the next few years, the nature of the lighting and cooking load being very attractive when viewed from the standpoint of the producer gas central station. To the heating of houses producer gas is very well adapted technically, although here, too, special burners will have to be applied if existing furnaces and open grates are to be used. But the nature of the house heating load is such as to leave no apparent commercial attractions whatever. To meet the extraordinary demands of a few very cold days, relatively enormous plant and distribution equipment must be maintained throughout the year.

It is conceivable, however, that under conditions existing in some cities it would prove practicable on some house heating business. The extent of this business profitably handled can only be determined by experiment. Any scheme tending to equalize the load throughout the day will, of course, extend the limits of the house heating phase of this problem. Allowing again that gas may be burned with 20 per cent. higher efficiency than coal, the parallels develop as follows:

Cost of 136 B.T.U. Gas per 1,000 Cubic Feet.	Equivalent Cost of 11,484 B.T.U. Coal per 2,000-pound Ton.
$.023	$4.47
.027	5.25
.03	5.84
.035	6.82
.04	7.79
.045	8.76
.05	9.74
.055	10.71
.06	11.68
.07	13.64
.08	15.58

In other words, 136 B. T. U. gas at 7½ cents per 1,000 would heat a house as cheaply as would 11,036 B. T. U. coal at say $14.50 per 2,000-pound ton. While at first glance this seems high, the fact is that there are thousands of families who would gladly pay this price for the advantages of gas heating.

For the firing of steam boilers, producer gas may find a very large field, as its use increases the evaporating capacity of the surface exposed and increases the life of the boiler by doing away with present great fluctuations of temperature in the sheets while rendering possible the automatic control of steam generation and the total elimination of smoke. There is to-day in England a concern installing producer gas fired boilers under guarantee to effect either an increase of 20 per cent. in evaporative capacity with present fuel consumption, or a reduction of 20 per cent. in fuel consumption with present evaporation.

These offers seem rather too optimistic, but it is a fact that, with proper furnace arrangement, a given thermal value in producer gas form will evaporate considerably more water than will that same gross thermal value in the coal, because of the nicer control of combustion possible with gas. The writer is aware that many failures are recorded against gas firing of boilers, but with proper furnace arrangement the required thermal efficiency can be obtained. The commercial practicability is now dependent solely on relative prices.

Summing up, we may reasonably expect to see practically all gas engine business taken from existing artificial gas companies, first by individually produced installations and later, in some cities having large and continuous power requirements, by producer gas central stations. These producer gas central stations will also be able to handle successfully considerable furnace work now done with coal, oil and other commercial gases; and they will doubtless extend, as the development of appliances allows, into the lighting and cooking fields with the possibility of adding as much house heating as local conditions of load and plant capacity allow.

While this does not mean that the properties of existing artificial gas companies are in immediate danger, it does mean that things have changed since the days when sure failure lay before all fuel gas schemes, and that to-day the distribution of fuel gas has a distinct field not then available, for the real development of the gas engine is a matter of recent years.

But, since the conditions warranting the installation of producer gas, central stations at present are found in only a few cities and in those few could be made of interest to investors only after an extended period of education, it appears that the individual producer plant will, for some time at least, provide the only serious competition to be met by the companies here represented.

Discussion.

The President—Gentlemen, this is a most interesting paper, which I hope will be fully discussed, more, however, for the things it contains that are not facts than those which are facts. I mean by that that it contains an intense amount of most valuable information for us all, but I think the general conclusions to which it points as to any possible competition from this source is—well, I am a heap more afraid of the ghosts of the people who died last year. (Laughter.) I will call on Mr. Lloyd to favor us with a few remarks on this subject.

Mr. Lloyd—I do not know, Mr. President, why you should think I have so much information on the subject of producer gas.

The President—Well, all kinds of gas, Mr. Lloyd.

Mr. Lloyd—From a technical standpoint I agree with Mr. Lea's conclusions, but from a practical standpoint I doubt very much whether the central station distribution, except to a very limited extent, would come into active competition as seems to be suggested. We can secure a basis of comparison to some extent from the steam heating which is being attempted in a great many places. In a house which we occupied in Detroit I think the cost is probably from 50 to 75 per cent. more than it would be with an individually fired boiler, and yet there is no question but that it is much more desirable, and the occupants will pay the additional price rather than be bothered with the individual boiler. While that does not apply to the same extent as a commercial proposition, at the same time as against an engine only occupying a very small space, a 25-horse power engine would not occupy much more than 10 feet square with all its appliances, and comparing that with a producer gas plant occupying considerable space, requiring constant attention, whether running or not, or in other words, involving large standby losses as against the ability to simply open a valve and have the engine supply the power, there is a range for considerable difference in price. What those prices will be from the standpoint of artificial gas companies is a matter of development. I have always personally believed in very low prices for special service. To-day we are selling to gas engine users, not universally, but in quantities, of 300,000 feet and over, at 60 cents, and we are contemplating reducing that price for quantities of 1,000,000 feet and over to 50 cents, with possibly an inter-

mediate step of about ¼ or ½ a million at about 55 cents. Whether we will ever be able to get below 50 cents I am not at the present time prepared to say, but I believe it can be done, because not only does the cost of production decrease as the quantity increases, but we are at the same time building up very valuable residual markets. At present we can sell all the coke which we can make at $5.25 delivered to the consumer. It costs us about 40 cents a ton on an average to deliver that coke, and the market price of coal is about $2.65 in the shed. We have determined that we are not supplying more than ½ of our customers with their furnace fuel. Consequently we have a very large expansion for fuel demand, and we are not at all alarmed, therefore, that we will ever have a surplus of coke which we will have to get rid of so long as the present price of anthracite continues to be maintained. I know a great many people are getting rid of their coke at less prices than that, and I think some of the people in this room know it, but I do not believe it is necessary. I say that as based on our own experience. If we can make a legitimate profit out of a market commodity which is not subject to franchise complications nor regulation as to price then we can afford to sell our gas at a closer margin of profit. If we do that we encourage an industry which will require a comparatively small investment, and that again indirectly encourages the consumption of gas at ordinary prices. We had a peculiar experience in furnishing this particular gas, in that the heaviest demands came on us in the months of December and January, at a time when we had supposed it would be so serious a disadvantage that we provided in our contracts the right to cut off, if the supply to the city should seem to be in danger through our meeting this heavy demand during those months. We have not found it necessary to take advantage of that clause of the contract as yet. Our holder capacity is between 70,000 and 80,000 feet, and we are sending out about 135,000 to 170,000 as a peak load. We were further suprised to find that the engine consumption assisted us with our limited holder capacity, because in order to meet the large demand we had to run at such a rate in our production end, that if we had not had the engines to draw away the gas, that is in the morning until evening, we would have been obliged to run at a disadvantage, but by ending up at 9 o'clock with 15,000 or 20,000 feet of gas in the holder we were able to produce practically at a full load until 6:30 A.M., when the engine load came on and held us down so that we simply gathered up our holder full by 6 o'clock. We had not anticipated that condition, but it was one of the developments. I think many more developments of that character may come out through a little further experimenting. We found another existing condition as a matter of competition. To this same power user the electric company is offering current for motor purposes, if I am not mistaken, at 2½ cents per kw. Engine gas at 60 cents gives them their power at a trifle of an advantage as against electricity at those prices. Our electrical friends may be able to figure something out of it, but I am not sufficiently posted on that subject to make any comment on it. Whether it will work out larger units, or how profitable that price will be to the electric company, I do not know. I do know that the engine is running under full load and the motor is shut down. For the installation of a large plant as previously referred to, I think the standby expenses will deter a great many manufacturing firms from using gas under the conditions referred to. I doubt if we will have any particular interest in the use of gas engines of 250 or larger horse power, but our experience with 125-horse power engines convince us that we will be able to hold that customer at a rate of not less than 50 cents, and at that rate gas in quantities of 1,000,000 feet per month will be profitable to us, taking into consideration the steadiness which it gives to our load, the reduction it works in our entire production and the increase of our residuals which we can dispose of advantageously. Furthermore, in a commercial proposition the investment is always a serious consideration. A manufacturing firm might be able to save some money possibly if it would install a very large and expensive plant, but there is always the pressure for dividends, and the pressure to hold down investment, and a great many concerns will operate under a somewhat larger running expense if the investment which might be rendered idle by slackness in trade is avoided, and that will give us a very powerful factor. Beyond our present power of 125 I cannot, of course, give any information which would be more than a mere matter of speculation, but that is the experience we have developed with that sized engine.

Mr. J. H. Maxon—Mr. President, there is a question pertaining to the distribtion of producer gas which I would like to hear information on. It is evident that producer gas distributed from a central station must be done by other means than from holder distribution, as the size and investment in holders would be extremely heavy and, therefore, compressors must be used. I would like to know what decrease in value would occur in producer gas of say 125 to 150 B.T.U. value as compressed and distributed to any distance? If producer gas is to be sold commercially from a central station it is probable that the distance to be delivered will in some cases be great, and the point I want to ask is whether the gas would depreciate in value to any great extent if sent out to any distance.

The President—Gentlemen, there are, no doubt, a great many people here who can answer that question. I will call on Mr. Lea.

Mr. Lea—In the current practice of distribution of carburetted water gas and of coal gas under pressures as high as 30 pounds, no such difficulty is at present experienced. The only thing feared was that the hydrocarbons would to some extent be dropped through compression. In producer gas the only hydrocarbons handled at all, speaking generally, are CH_4 and C_2H_4. Neither of these gases is affected noticeably by either compression or distance traveled in distribution. It seems altogether safe, therefore, to say that there is no loss in thermal value of producer gas due to compression or distribution.

The President—I wish Mr. Lea would explain to the members what he means when he says that compression takes the place of holder capacity. I have not found anybody who seems to know, and as I myself am in ignorance on that subject, I would, therefore, like to hear from him on it. In other words, just describe exactly what arrangements as to compression are used.

Mr. Lea—With reference to the method employed to get along without holders, it is intended to rely on the reserve capacity of the high pressure main system, and by calling in the reserve producers as required by drops in pressure in the high distribution system. The compressor can be kept running at variable speeds so as to maintain the pressure of the distribution system, and can thus be rendered just as elastic to all intents and purposes as in the ordinary storage system. You have two elastic points, the main system and the reserve producers. I would like it to be understood clearly that I do not expect to see any producer gas central station work, to anv great extent, in America for some time to come, but I simply wrote this paper for the purpose of showing that there are certain possibilities in producer gas which I do not believe have been generally recognized, and that there are certain other possibilities with reference to producer gas which have been largely talked about, but which I do not think can be realized. With reference to the plant at South Staffordshire, they are operating over a large territory and they are investing an enormous amount of money. I do not believe in America any such conditions will be found as are found there, or that any such conditions will be found as would warrant a company going into the business. I do not believe we are going to have any trouble from central stations except in relatively small and restricted areas, where it will be almost altogether a matter of power for driving a mill or something of that kind.

Mr. Gardiner—I have been very much impressed by Mr. Lea's paper, and I would like to refer briefly to certain experiences which we have had at Boston, and which I think may be of interest, relating to the matter of gas engines and producer gas. Some 3 years ago a gentleman who was formerly from Milwaukee began moving around through the territory with producers. He installed one at Cambridge. It worked, and having inspected it I was very much impressed with its possibilities. It seemed to me it might grow, and it did. We were increasing our activity in seeking development of gas engines and the use of gas in gas engines, and we found that there were quite a number of producers. We had one gas engine that was supplanted by a producer, and our meter was kept there on the readiness to serve basis without paying for it, simply to use in case it was needed, at our expense—we sell on a flat rate by meter. The producer proceeded to produce. That was followed up by a complete producer plant with several engines amounting, I think, to 50 or 75-horse power, and gas meters and gas service on the readiness to serve basis were continued at our expense. So in that instance they were increasing very distinctly. On the other hand, I beg to differ as to the opinion expressed that a gas company's supply to a gas engine is probably limited to 125-horse power. Within the last 2 or 3 months we closed a contract with the *Boston Herald*, which is one of the largest papers in Boston, and which is building an entirely new plant, new building, new everything right through. It is making everything ideal, and as one of the features of this idealism it is putting in direct connected gas engines for its sole supply of light and power. The contract calls for Westinghouse gas engines, virtually amounting to a plant of nearly 300-horse power. The *Boston Herald* Company retained a very eminent firm of consulting engineers to lay out the entire printing plant and power plant. The plan was thought out for months. The owners went all through the different phases of steam, producer gas and city gas engines, and of

electricity, and in Boston I should say we are up against one of the keenest competitive electric companies that I know of. They are very active in their competition. However, we won out and secured a contract to supply three 85-horse power gas engines, direct connected, and one 35-horse power engine under those conditions. The Boston Edison Company sells very low indeed on its basic prices. The *Herald* plant is only one of quite a number of gas engine plants where we are furnishing gas for engines of 25 and 50-horse power and so on. That is the largest, however. With reference to this question of producer gas generated in isolated plants as against other commercial gases, it seems to me that, while gas is sold on a flat rate by meter, the customer would tend, and in our case we find he does tend, to use the city supply where he is a short-hour burning customer, and possibly an unprofitable customer, even though his quantity may be large. On the other hand, where he is a long-hour burning consumer, as are many manufacturers, he will lean to a producer. If we can size up a man's load factor then we can know fairly accurate what we are up against in the way of competition. The question of producer gas supply from central stations it seems to me is germane to another movement in the gas business which I think may be of pertinent interest here, and that is the distribution of low candle power and high calorific power gas from central stations. For instance, in Germany gas is of low candle power. It has candle power simply "because it happens to have it," as I was told by an engineer who made a local investigation last summer. The sole reliance is placed upon the calorific value of gas, and the calorific value I believe is something over 500. There we have an entirely different situation from the distribution of producer gas, and a situation of which it seems to me a gas company might very well avail itself. If we can manufacture calorific gas from coal by distillation, or by water gas process, of over 500 B.T.U., we can manufacture, distribute and use it in our ordinary methods of distribution without marked modification, and can compete very much more broadly with other forms of fuel, because to begin with our gas will be free from enrichment expense. All our gas will be free from enrichment expense and we can thus develop a very profitable by-product. Having done so we can, from that saving alone, reduce the cost and consequently reduce the average price of our gas considerably. By doing so we will find still further markets for it, and as a consequence further reductions will become possible. It seems to me that this question of low candle power and high calorific gas from central stations is a thing worthy of the careful consideration of the central station gas men, and a thing which promises very much more, both in the physical and financial results, than the possibility of producer gas from central stations, and incidentally I might point out that this distribution of low candle power, high calorific gas will perhaps become the means of meeting, in so far as possible, the competition from isolated producers. (Applause.)

Mr. Schwarm—I would like to ask Mr. Lea a question, referring to that part of his paper under the item of depreciation, wherein he says, "In addition to operating charges we must allow, say, 15 per cent. on $150,000 to cover interest, depreciation and taxes on plant, buildings and real estate." I would like to know what part of the 15 per cent. would apply to the producer apparatus?

Mr. Lea—I would say that it will run somewhere between 5 and 7½ per cent.

Mr. Schwarm—Just the apparatus alone?

Mr. Lea—The complete producing apparatus.

The President—I would like to ask Mr. Gardiner if the producer plants which he has mentioned as competing with his Company supplied more than one concern, or did each concern have its own producer plant?

Mr. Gardiner—No, sir; they were individual, each one supplying its local plant. There was no general distribution at all.

The President—Speaking from experience in furnishing gas for heating and for cooking, I think any gas man can put aside any question in his mind that any central station plant furnishing unpurified gas of 136 heat units will ever worry him the least bit for those purposes. The demand comes suddenly and this gas cannot be stored. To be burned economically it must be burned without flues, and impure gas cannot be burned in that way. If it is carried any distance it must be carried through large pipes. Gas of low efficiency must be carried through large pipes. For the production of power it seems to me a very successful plan. I think Mr. Lea has given every gas man all of the facts about it, and in that way he has certainly done us a great service.

Mr. Gardiner—I should like to add one word in connection with the distribution of producer gas from central stations. It seems to me, viewed from a commercial standpoint, it would not be of a character such as to produce low operating costs in the distribution system. The load factor would of necessity be very low, and the fluctuation of the load between summer and winter would be very great indeed. Furthermore, in winter, taking an average temperature of 32° F., that would give us a steady winter load, but frequently throughout the winter down goes the thermometer to zero or below, and the consumption of fuel during those brief intervals goes away up, I may say it would double or treble, and must have some plan to meet it if we are supplying fuel gas; but who is going to pay for it?

The President—Another varying factor of importance is the difference in consumption throughout each day. The breakfast hour will call for one-fourth of all the gas demanded during the whole day and you have to provide for that demand; you must have a holder to carry it. Mr. Andrews, am I right?

Mr. Andrews—I think you are, Mr. President.

Mr. Forstall—As the gas plant at South Staffordshire, England, has been referred to, just as a matter of information, I may say that in coming out on the train to this meeting I was reading an account of the annual meeting of that Company which occurred at the end of the first complete year of its operation. The results thereof were that its operating expenses were £9,000 more than the receipts, in view of which fact the Directors gave up all of their allowances for the year and did their work for nothing, and the account of the meeting says, there was great dissatisfaction expressed among the stockholders.

On motion a vote of thanks was tendered to Mr. Lea for his paper. The President announced the details of the entertainment arranged for the ladies, after which a motion to adjourn until 2 P.M. was adopted.

(To be Continued.)

The Dibdin-Woltereck Gas Manufacturing Process.

The *Gas World* reports, concerning the experimental installation at St. Albans, as follows:

For several years past, first at the Sutton gas works, and latterly at St. Albans, Mr. W. J. Dibdin and Dr. Woltereck have been carrying on working scale experiments in gas making from oil and steam, in presence of iron. The reaction, of course, is old, and we are not aware that any claim for novelty of principle has been advanced in this connection. It is an age, however, of retrial of old proposals, which, good in themselves, may have failed by reason of defects of details, and perhaps also of lack of sufficient opportunity. Consequently, there is no reason of a general character why the original iron steam process of water gas manufacture should not be given another chance, with all the modern advantages and additions that have entered into gas works practice since the late R. P. Spice tried his hand at it. In the Dibdin-Woltereck process there can be recognized an interesting blend of the ancient and modern, the iron steam reaction being combined with oil gas manufacture on the most approved lines. Having regard to the elegance of the reaction, and the neatness with which it can be exemplified in operation, one might even go so far as to express the opinion that another attempt to give an industrial embodiment and commercial value is quite in order at the present juncture.

Nature of the Plant and Method of Working.—The experimental setting at St. Albans is the work of Drakes' Limited; and the first point about it that strikes an observer (writes a representative of the *Gas World* who was permitted to inspect it on Thursday) is the great advantage that modern carbonizers, whether of coal or oil, enjoy, as compared with their predecessors, in the equable heating and perfect control of retort temperatures rendered possible by gas firing. There are in the setting, which is 5 feet 6 inches wide, 3 retorts, 9 feet 9 inches long, shaped as rectangles with rounded corners, 18 inches by 6 inches inside, set with the long dimension vertical. These retorts are of iron cased in fireclay. They are packed, closer than is the case with an ordinary surface steam condenser, with ¾-inch iron tubes, 6 feet 6 inches long. This constitutes the working surface. At one end of each retort there is a mouthpiece, to which is fitted a spray injector for the oil and superheated steam. At the other end are mouthpieces carrying ascension pipes of the usual pattern, connected to dip pipes, and a short length of hydraulic main. There is a separate condenser and exhauster for the setting, and the gas passes straight into the holder.

The steam superheater is a returned pipe carried in another pipe passing through the upper part of the bench, under the arch, where it gets a dull red heat. The oil feeds for the retorts are visible, and can be regulated by cocks to the working capacity of the retort.

Really, therefore, the operation of the plant is extremely simple,

being not more delicate in any way than the ordinary manufacture of Pintsch oil gas, to which process it presents a superficial resemblance. Solar distillate is fed with a continuous dribble from an overhead tank through the sight feed glasses to the injectors, and that is all there is to be seen. The steam is superheated to 250° C., and works at about 20 pounds pressure. Of course, a balance has to be maintained between the temperature of the interior of the retorts (which should be an ordinary good carbonizing heat) and the flow of oil and steam. The action, being strongly cooling, cannot be forced. Clearly, when the process is installed on a large scale, this point will need particular attention with regard to the construction of the retorts. The working results are a production of 1,000 cubic feet of gas for a consumption of about 2¼ gallons of oil, *plus* water; the illuminating power being 16 to 17 candles, and the calorific power about 620 B.T.U., net. The gas contains about 45 per cent. of hydrogen, with 7 per cent. of carbonic oxide.

The Principle of the System.—This may be shortly described as consisting of a continuous oxidation of iron and its simultaneous reduction. The action of the steam is to attack the metal exposed to it, with the formation of the black ferric oxide and the corresponding liberation of hydrogen. This was the old water gas process and is also the basis of the Bower-Barff iron protecting process. If it went on by itself, before long the metal would be coated with the oxide, and the steam would pass undecomposed. But the accompanying oil corrects this. Part of the oil gets cracked up into gas and the lighter hydrocarbon vapors, which get gasified later on, whilst the remainder sticks to the iron oxide, which it reduces to the ferrous, and ultimately to the state of "reduced" iron—not metallic. The metallic state, once destroyed, cannot be restored in this way; so that the last state of the iron is one of disintegration. Then it is ready to act upon the steam afresh, and again gets oxidized, and again reduced *ad infinitum*. Such is the theory, and it appears to be realized by experience extending over a considerable period of time. Plainly, on this order of oxidations and reductions, no weight must be added to the contents of the retort and nothing taken from it. There must be no carbon or other deposit, the whole of the oil eventually passing away as gas—which is testified to by the appearance of carbonic oxide in the product. It seems almost too perfect a compensation to be true; but the facts are witnessed by competent examiners who know what to look for. If there were a screw loose in the order of the process the retort would very soon get into such a state that its error would speak for itself. But it appears to go on quite satisfactorily.

Control of the Process.—One of the great advantages of this process is the facility with which the quality of gas made can be regulated at will, within rather wide limits. If a poorer gas is desired, it is only necessary to check the consumption of oil. The steam will go forward and the water gas will be less heavily carburetted. On the other hand, the oil feed can be increased to a considerably higher figure than the mean, without choking the retort. This, however, would be the result if the oil were much in excess; which, again, is a matter of the length of the retort. The working capacity of the short retorts at St. Albans is, of course, soon attained. One day this month, working quietly, they made 8,800 cubic feet of 16 to 17-candle gas from 25 gallons of oil, and they will carbonize two gallons of oil an hour for the three mouthpieces. Possibly they would make more. This account of the working must not be taken as in any sense a test statement. Our representative went down to the works without notice, and merely jotted down a few figures from the daily log sheets. The present object of our report is simply to place it upon record that the experimental plant works, and, so far as can be observed, realizes the expectations formed, both of the character and value of the combined process. That is the main point. Questions of commercial advantage can be left to settle themselves when the process is worked on a commercial scale. The cleanliness, neatness, silence and general good behavior of the plant speak to the eye of the most casual observer. Here is a system of gas manufacture using oil which produces a gas almost identical in composition and character with good coal gas. It does this without labor, moving machinery, or nuisance of any kind. The whole plant and process are absolutely inoffensive and unobjectionable, and no purification of the gas is requisite, unless the oil happens to contain a large quantity of sulphur. There are no residuals. Oil, water and fuel are the only raw materials to go into the works and gas is the only product that goes out. There is a small condensation of steam, because this never enters into ideally complete combination with the material in the retorts. We have said enough to make out a *prima facie* case for the Dibbin-Woltereck system, as actually working at St. Albans, and at the present juncture, in the affairs of the gas industry, when the most progressive and experienced engineers are seeking on all sides for new ways of satisfying the public demand for a strong, pure gas, information respecting this interesting experiment must be regarded as well-timed.

The details of the process may, and probably will, undergo further modifications before the system assumes its definitive type. We have not been curious to criticize what is being done; but merely to describe the installation, its principles and the results that have so far transpired, and are quite sure that this is a straightforward, honest endeavor to make another addition to the resources of the gas industry.

Briquetting of Fuels and Minerals.

By Mr. G. J. Mashek, in *Iron Age*.

An experimental plant for manufacturing coal briquettes was built in Jersey City, N. J., some 4 years ago by the Zwoyer Fuel Company, for the purpose of trying a patented binder, which proved a failure. This plant had a capacity of 5 tons per hour and its equipment was designed by the author. After experimenting about a year with all known binding materials, the company finally adopted coal tar pitch or asphalt as being the only one that could be obtained in practically unlimited quantities and at a reasonable price. A process for applying the binder was developed, which consisted of atomizing hot melted pitch into a mixer containing the heated and dried coal dust. The object was to diffuse or scatter the pitch in a spray so as to cover each particle of coal with as thin a coat of pitch as possible, the mixer being speeded up in order to keep the coal dust in practically a suspended condition. This process produces good results when used on short mixers, and when less than 5 per cent. of pitch or asphaltum is used. In the 2 following years about 3,000 tons of briquettes were manufactured and sold, and this small plant was pronounced a commercial success.

In the winter of 1904–5 the New Jersey Briquetting Company built a new plant in Brooklyn of 15 tons per hour capacity, equipped with improved and heavier machinery, a general plan of which is shown in Fig. 1. Owing to the limited space only a small storage room for dust

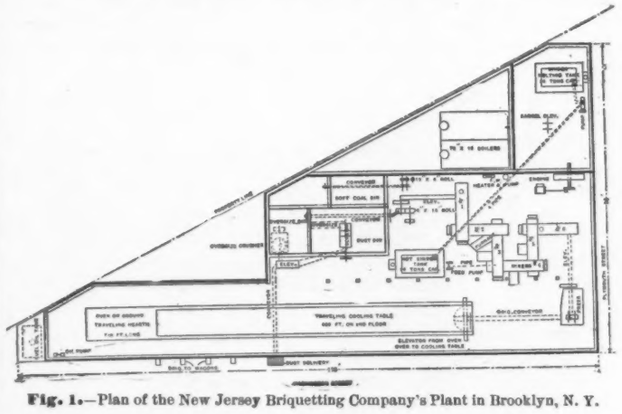


Fig. 1.—Plan of the New Jersey Briquetting Company's Plant in Brooklyn, N. Y.

was provided. It was the intention to use the pockets of an adjacent coal yard to store dust and briquettes, shipping the product from the yard. An overhead tramway was to convey the dust to the briquetting plant and take briquettes to the storage bin on the coal dock. Unfortunately after the plant was built the city took a strip of property between the plant and coal dock, so that this overhead tramway from dock to plant could not be used. The loss of this approach to the dock seriously interferes with the operation of this plant, owing to the expense and difficulty of getting the dust to the plant and the small storage capacity of the bins. The dust has to be hauled by wagons to a conveyor on the street side of the plant and the briquettes are hauled away in the same way. Small briquette pockets were built under the cooling table floor, holding about 6 hours' run of briquettes.

Referring to Fig. 1, the dust is conveyed from the sidewalk pit to an elevator, from the head of which it is spouted upon a screen placed over a 200-ton dust bin. The over sizes go to an over size bin, then through a coarse crusher, being reduced to about ½ inch, and the discharge from the crusher goes back into the first elevator and over the screen again. From the bottom of the dust bin the material is taken out by a conveyor run at a speed equal to the capacity of the press. The material from this conveyor then passes between a set of 16 by 36-inch crushing rolls, which are set to reduce it to the size required for briquetting. Next to the dust bin is an 80-ton soft coal bin, fitted to

feed by means of another conveyor to a set of 4 by 19-inch rolls. This bin and set of rolls was put in with the object of adding from 3 to 8 per cent. soft coal to the anthracite dust, in order to make the briquettes remain hard in the fire. Experience, however, has proved that the addition of soft coal is not necessary to make any briquette remain hard in the fire, if the dust is properly treated before and after passing through the press. Both these roll crushers discharge into an elevator which elevates into the mixers.

A general plan of the mixers and a typical section are shown in Figs. 2 and 3. All the drying and heating of the dust are done by direct

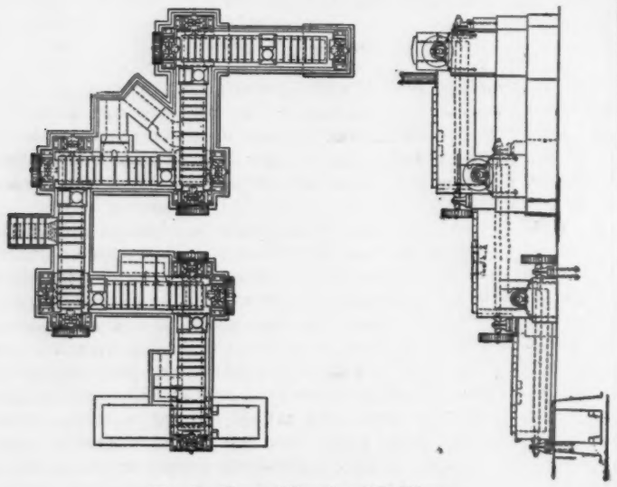


Fig. 2.—Plan and Elevation of the Mixers.

heat from oil furnaces, which are regulated so that all the heat is absorbed by the dust, the stacks remaining practically cold. After the material is sufficiently heated the pitch or asphaltum is pumped into the tail end of mixer No. 3 by a special rotary pitch pump, which is set to deliver the correct quantity of pitch as determined by the operator. The blades in the mixers are shown in Fig. 3. The shape, pitch and

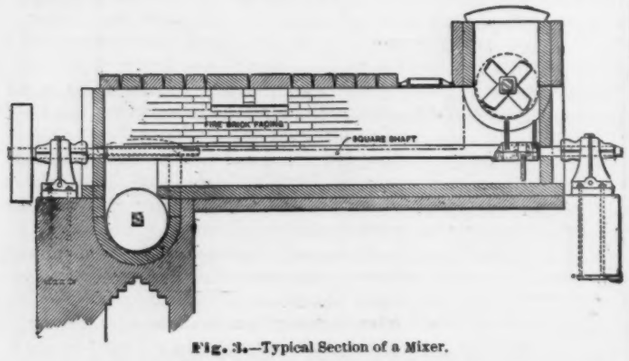


Fig. 3.—Typical Section of a Mixer.

curvature of the blades are slightly different in each mixer, and the speeds vary somewhat, the average being about 175 revolutions per minute. The length and number of mixers are determined by the material to be briquetted, depending on the fineness of the dust, its specific gravity, moisture carried, etc. The mixers used in this plant turn out a perfect mixture irrespective of whether the pitch is atomized or put through a pipe or strainer, unless, as before stated, less than 5 per cent. of pitch is wanted; then the atomizing makes it somewhat easier to make a thorough mixture. This plant, however, has been run for months without atomizing the pitch, and a perfect mixture is being obtained. The application of atomizing the binder into this form of mixture is patented.

The material is discharged from mixer No. 6 into an elevator which takes it to the press hopper. The press which is shown in Fig. 4 is a rotary machine, having 2 rolls with pockets in their faces the shape of the briquette. The rolls are geared so that the pockets register and parallel adjusting devices are provided. The hopper is placed directly over the rolls. All bearings are self-oiling, the oil wells being looked after about once a month.

A section of one of the rolls is shown in Fig. 5. It is made up of disks, the sides of which are machined, then assembled on the shaft

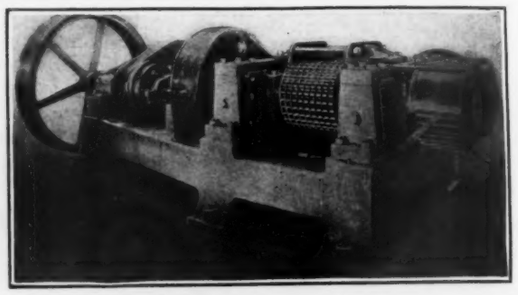


Fig. 4.—The Rotary Press for Forming the Briquettes.

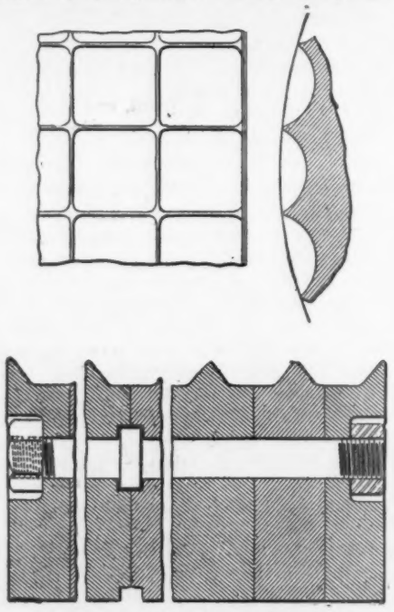


Fig. 5.—Details of one of the Rolls.

and held together by bolts, as shown. A shoulder on the center of the shaft holds the assembled roll in place. The construction of a roll made up of disks as shown, is also patented.

The size of the briquettes is important, and they must be of a size suitable for the purpose they are intended for and the coal they are made of. The same rule that governs the size of natural coal applies to briquettes. A specimen briquette produced by this machine is shown in Fig. 6. It will be seen that no waste material passes the

Fig. 6.—A Finished Briquette.

rolls, and the shape is such that the briquette will not stick in the molds or pockets. The capacity of the press is 15 tons per hour of the present size of anthracite dust briquettes, and can be increased to 18 tons by running the plant a little faster. This press requires no attention after being started.

From the press the briquettes are conveyed to an automatic baking oven if smokeless briquettes are desired, and from the oven they are taken by an elevator to the cooling table, after which the product is ready for use. If it is not desired to bake the briquettes they are taken to the cooling table direct and the oven is cut out. Experience has shown there is no objection to unbaked briquettes, even in New York

city, as the pitch burns off in a few minutes after they are put on the fire, with a short white flame. Both the oven and the cooling tables are made up of traveling steel plates, a distributer being used on each to spread the briquettes to an even thicknesss. After passing over the cooling table the briquettes are either elevated or dropped into bins.

The pitch plant consists of a special tank set in brickwork for melting the pitch. This tank has a capacity of 25 tons of pitch. The pitch, brought in barrels, is taken to the second floor on a barrel elevator, where the staves are knocked off and the contents thrown in the tank. After the pitch is melted and heated it is pumped to a reservoir tank ready for use. The tank is similar to the melting tank, and in it the pitch is kept in a heated state for use. The whole plant is driven by an 18 by 24-inch engine, developing about 140-horse power at 140 revolutions per minute.

The plant is entirely automatic, no hand labor touching the material, and has been run whole days by 2 men. A full complement of men consists of five, a foreman and plant runner, an engineer, an oiler and assistant plant runner, a pitch melter and a dust feed and cooling table attendant. The cost of operating the plant, exclusive of fixed charges and coal dust per 1 ton of ordinary anthracite briquettes, is 92½ cents. This includes:

	Cents.
Coal tar pitch	44
Labor	12
Fuel	20½
Lubricating oil	01
Running repairs	10
Rebriquetting dust from briquettes	05
Total	92½

Owing to the location the cost of this plant was high, being $32,000 for machinery and $35,000 for steel buildings, foundations and erection of machinery, making a total of $67,000. The average price obtained for the unbaked briquettes in February, 1906, was $6.60 per ton, delivered—35 cents higher per ton than the best anthracite coal. The total product is readily disposed of. The plant has been in operation since August, 1905.

The advantages possessed by this equipment over plants in Europe are its large capacity per hour, its being entirely automatic, making the labor cost low; and its making briquettes that remain hard in the fire and that can be shovelled and handled like ordinary coal. This plant has been tried on all kinds of coal, lignites and coke breeze from different parts of the country with equal success. Test runs have shown that from 6 to 9 per cent. of pitch is required on the different fuels to make briquettes that will stand transportation and handling, all depending on specific gravity, hardness and fineness of dust. Good anthracite coal dust requires the least, usually 6 to 7 per cent. When only 4 to 5 per cent. of pitch was used it was necessary to use a small quantity of soft coal in order to hold the briquette hard in the fire, but with this small amount of binder they are not hard enough to stand even the usual wagon handling without a large amount of breakage.

Interior Illumination.

At the April meeting of the Illuminating Engineering Society, which was held on April 12, a general discussion was had on the subject of interior illumination, introductory papers being presented by Mr. R. M. Searle, of Mount Vernon, N. Y., and by Mr. Douglass Burnett, of Baltimore, Md. The Secretary reported that the membership to date was 390, and it was announced that the next meeting would be held May 11, at which street lighting by incandescent lamps would be the topic of discussion.

The paper by Mr. Searle dealt specifically with the proper use of gas lamps, and pointed out the necessity which exists for teaching the general public to employ the most efficient and effective burners for each class of service. One of the greatest sources of loss is found in the absorption of the light rays by the globes. A portion of the loss may be attributed to the frosting on the globes, but in most installations the major part of the existing loss is caused by the deposit of dirt on the globes, which deposit is usually much greater with frosted than with clear globes. Poor and uneconomical service can often be traced to improper supervision of the lamps, and in this connection, too much stress cannot be laid on the importance of using good tips. In selecting the locations for the lamps due regard should be had to the possible service which each lamp can render. A slight change in the position of a lamp may cause the light from it to serve more than one purpose, and in installing the lamps utility should not be sacrificed. It is to the advantage of the gas company to encourage the use of portable reading lamps. The author expressed the opinion that each person should work for the common good of illuminating engineering.

The paper by Mr. Burnett pointed out the great importance of securing definite information or rules by which lamps, and particularly electric lamps, should be arranged for obtaining the proper illuminating effect. The illuminating engineer should be well versed as to the characteristics of the various illuminants. The author presented a long list of questions relating to specific lighting problems, in order to invite discussion concerning them. He expressed the opinion that arc lamps are hardly to be considered acceptable for illuminating furniture stores or for general office lighting, and that incandescent lamps are not best suited to department store lighting. It is desirable that some definite agreement be reached with reference to the unit of illumination; that is, whether the units should be candles or watts per square foot of floor area or cubic foot of room volume, or whether the foot candle unit should be used. Already some very good results have been obtained by planning the illumination on the basis of from 1 to 2 watts per square foot.

Mr. V. R. Lansingh discussed in detail several of the lighting problems mentioned by Mr. Burnett. He stated that the object in illuminating a store window is both to attract attention and display the goods. All lamps should be hid so that the light does not directly reach the eye of the observer. If border lamps are used they should be well shaded. In regard to the different styles of reflectors, it may be stated that the trough type is not as effective as the cone type, due to the limited area and position of the reflecting surfaces. Store fronts should be illuminated by lamps in the window and not by arcs outside over the street. For large jewerly stores arc lamps have been found to give excellent service. It is important to eliminate all glare when office lighting is being arranged, and for this purpose the office lamps should be of small candle power and well distributed. In theaters the illumination should be so designed that no lamps are placed below the balcony or in the line of vision between the spectators and the stage. It is incorrect to assume that only arc lamps are suitable for department stores, because illumination can be carried out with excellent effect by means of incandescent lamps.

Dr. A. H. Elliott stated that with both gas and electric lighting excessive fatigue of the eye is produced when the illumination is irregular or the light is of improper color. The physiological features of illumination present numerous problems which should receive careful and thorough study. He indorsed the several statements made by Mr. Searle's paper with reference to gas lighting. The extremely small openings in globes at the present time may be attributed to the continued use of antiquated fixtures.

Mr. W. S. Kellogg, speaking from the point of view of the architect, remarked that more trouble arises from the excessive brilliance of the illuminants than from the lack of illumination. It is of prime importance to consider the distribution of the lamps.

Mr. T. J. Lytle, Jr., in continuing the discussion of the disadvantage arising from using concentrated illumination, pointed out that the objection which had been urged against the Welsbach gas mantle on account of the excessive whiteness of the light had been overcome in a recently developed mantle which affords a yellow white light. This latter form of lamp is even more efficient than the glaring white mantle. The most effective illumination is that obtained from tinted-globed lamps used in a room with white ceiling and cream-colored side walls. The inverted gas burner has been found to be quite efficient, and it is especially advantageous for decorative effects. The real problem which confronts the illuminating engineer relates to the proper selection of glassware for the lamps and the color scheme for the rooms.

Mr. J. D. Israel congratulated the Society on the good work it is doing in bringing together the different companies in the lighting business, and expressed the hope that the contractors, architects and manufacturers would all get together for the good of illuminating engineering. The Philadelphia Electric Company maintains a special department whose members devote their whole time to illuminating engineering for the purpose of establishing cordial relations between the Company and its customers. Circular letters are sent regularly to the customers and to architects and contractors.

Mr. John Campbell stated that the major portion of the existing bad illumination is due to the misleading statements made by the different sellers of apparatus, and to the prevalent use of rule-of-thumb methods in deciding npon the number and location of the illuminants.

Mr. W. D'A. Ryan remarked that it is extremely difficult to get people to agree to use less light uniformly distributed. They insist on obtain-

ing an excess of brilliancy. Mr. E. L. Elliott thought that the fixture manufacturer should be instructed to build the fixtures to conform to scientifically designed lamps and shades, and that it is absurd to assume that the natural laws of light will be changed to conform to the desires of the manufacturer, who seems to wish to dictate just what shape of fixture shall be used.

The Philadelphia Foundrymen's Association.

There was a large attendance of members and guests at the 156th regular meeting of the Philadelphia Foundrymen's Association, held at the Manufacturers' Club in that city early this month.

Thomas Devlin, President, occupied the chair. The report of the Treasurer showed the Association to be in a flourishing financial concondition, there being a balance amounting to $2,422.27 on hand, with all indebtedness paid. Applications for membership of the Monarch Engineering and Mfg. Company, Baltimore, Md., represented by H. D. Harvey, and the Cyrus Borgner Company, Philadelphia, represented by Cyrus Borgner, were favorably acted upon.

A communication from the American Foundrymen's Association was read announcing the date of the 10th annual convention of the Association, to be held in Cleveland, O., June 5, 6 and 7, 1906, and to which the foundry trade is invited. After considerable discussion it was decided to invite the American Foundrymen's Association to hold its 11th annual convention, in June, 1907, in Philadelphia, and the following committee was appointed by the President to prepare and extend the invitation: Dr. E. E. Brown, Chairman; George C. Davies, Thomas Evans, Stanley G. Flagg, Jr., C. W. Asbury, W. S. Hollowell, E. H. Mumford, W. O. Steel, A. A. Miller, Cyrus Borgner, W. A. Pollock-Davis and President Thomas Devlin and Secretary Howard Evans, *ex-officio*.

The paper before the Association was entitled "Molding Sand and Mold Wash for Making Steel Castings," by Arthur Simonson, of Wm. Wharton, Jr., & Co., Philadelphia. Mr. Simonson treated the subject from the standpoints of the adaptability of the various materials for this use, the mixing of the sand and clay and the mechanical properties encountered in making the molds. The uses of materials for core making were also elaborated upon. This paper was printed in full in the *Iron Age* for October 19, 1905, under the title "Preparation of Molds for Steel Castings."

Dr. Elmer E. Brown, Chairman of the delegation visiting the Pittsburgh Foundrymen's Association, April 2, made a report covering the many interesting points visited by the party. Members and friends of the Association numbering 31 left Philadelphia April 1 in a special Pullman car, returning immediately after the banquet on Monday evening. The delegation was particularly pleased with the hospitality of the Pittsburgh Association, and the thanks of the delegation and the Association as a whole were extended to the Pittsburgh Association for the invitation and entertainment. After a vote of thanks to Mr. Simonson for his interesting paper and to Dr. Brown for his report of the Pittsburgh visit the meeting adjourned.

SPECIAL ENGLISH CORRESPONDENCE.

COMMUNICATED BY NORTON H. HUMPHRYS.

SALISBURY, ENGLAND, April 10th, 1906.

Vertical Retorts.—Gazine Again.—Some other Processes.

The prominent topic for this season, in gas engineering circles, is vertical retorts. The subject has been discussed in our technical press by such first-rate authorities as Mr. William Young and Mr. Ralph Herring. It has already advanced beyond the theoretical stage. The Woodall-Duckham retort is now a part of the generating plant in regular operation at Bournemouth. The Settle-Padfield system has been adopted in a few places. And in Germany, Dr. Bueb has had the matter in hand for some years at Dessau. Last month a paper was read before the Berlin District Association, by Herr Körting, of Berlin, describing the result of a visit to Bournemouth, and giving some fuller details of the working at Mariendorf. Herr Körting appears to have enjoyed his visit to the well known south coast watering place, and to have been favorably impressed with the district, the inventors and the new process for making gas. While it is known that the Woodall-Duckham retort has been in operation on a practical scale for some months, this is the first published description, I believe, that deals with the actual working in detail, and is merely a general account of a personal examination with no detail as to figures. The actual results so far obtained are stated to be that the apparatus has been worked continuously for 8 months, proving its practicability. The operations are conducted entirely within closed vessels so that the retort house is completely free from dust, smoke or steam, and can be kept as clean as a machine shed. There is a substantial reduction in the matter of retort house labor. With regard to what is being done in Germany, at Dessau a set of 10 Bueb retorts, each 13 feet 4 inches long, has been at work for 9 months and done thoroughly well. The yield of gas per mouthpiece and per ton of coal is high, the gas is of high illuminating power and contains very little naphthaline, the coke is large and hard, the tar is very fluid, and 50 per cent. more ammonia is obtained than from the usual horizontal arrangement. At Mariendorf settings of 12 have been tried and also a longer retort, 16 feet 8 inches, and these have been in use for four months. During the month of February the working results averaged about 15,892 cubic feet per mouthpiece and 190,704 per bench, in 24 hours. The yield per ton was 12,354 cubic feet, and the best calorific value was 576 B.T.U. A special experimental gas works plant, capable of dealing with 210,000 cubic feet of gas per day, is attached to one of the benches. Herr Körting claims that the vertical retort system has been proved to show a high yield per square foot of ground area covered by the setting, a large yield of gas without the usual falling off in photometrical and calorific value, a large yield per retort, a cure for the naphthaline bugbear, a rich thin tar, clean retorts and no choked ascension pipes or pitch in the hydraulic main, a substantial improvement in the quality of the coke, and a very considerable reduction of labor even in comparison with inclined retorts.

The vertical retorts only require attention once in 10 to 12 hours and the labor is restricted to a few manipulations. In the course of the discussion that followed the reading of the paper, Dr. Bueb said that Messrs. Woodall and Duckham had attacked four of the most difficult problems in gas engineering. These were the continuous feed, continuous distillation, continuous removal of the coke, and the utilization of the heat of the spent coke for gas making, the steam produced by its extinguishment passing into the retorts and going to make water gas. Of these he considered they could only claim success, so far, in respect to the first, and he was not hopeful as regarded the others.

There are several points in addition to the above, upon which one would desire to be informed before adopting vertical retorts on the practical scale. The first is the outlay including all accessories, stated in terms that admit of comparison with the usual system, say for a set producing 200,000 cubic feet of gas per day. Then one wants to know something about the working life and the cost of repairs and maintenance. There is also the question of the kinds of coal that can be used, whether the range is limited by any peculiar property. When inclined retorts were first introduced certain kinds of coal were found to be unworkable and for financial reasons it is desirable that any new process should expand the choice of materials and not contract it. But at the same time it is only fair to admit that Herr Körting shows that the solid and substantial advantages already proved quite warrant a favorable opinion as to the future of the system.

The few notes included in my February letter on the subject of gazine appear to have attracted considerable interest judging by the numbers of inquiries that I have received, some of which I take the opportunity to deal with. It will be evident from a perusal of my previous remarks that it does not involve the use of steam or other source of heat. I am also asked what it is and where it comes from, and in reply to that can only say that it presents the characteristics of a light petroleum distillate. It evaporates freely in the open air, and leaves no residue, and there is no question as to the capability of any ordinary gas to take up and retain the small proportion used at any ordinary temperature. I have not applied it at the scrubbers or any other portion of the plant, or for removing deposits at any point in the condensing or purifying plant, so cannot tell whether the presence of tar or condensed light oils would be prejudicial to its action, or whether, if added, say at the inlet of the condenser, it would be carried through to the holder. I have simply applied it in the manner recommended by the vendors, who advertize in our English gas papers. Another point that appears to have attracted considerable attention is the strong odor, and I am asked whether it could be used for odorizing natural or water gases. I can only say that I can distinctly detect the smell of it in the gas as supplied at my private house a mile or more from the works.

The vertical retort system is not going to have the field to itself or to be allowed a walk over the ground. Other processes are in prospect, and really the proper assimilation of all the various novelties that are

put upon the market is a serious drain upon a professional man's time. I think the gas manager who endeavors to keep himself acquainted with all that is going on must frequently be troubled with nightmare, in which retorts of all sorts and sizes, generator furnaces, transporting machinery, high pressure distribution, free systems of gasfittings, slot meters, and burners inverted and otherwise are mixed up together. The methane hydrogen process, which has already been described, is still in use at Truro and a set is being put down at Swindon. The Dibdin-Woltereck process, in which steam and oil are used for the production of gas, is being tried at Sutton and St. Albans. This appears to be an adaptation of the Pintsch and such like oil gas processes, as used for the manufacture of oil gas for railway carriages. The gas as produced in this manner is 60 to 80-candle power, and the novelty is to pack the retorts with iron tubes and to use superheated steam. A mixture of oil and water gas is thus produced and the quality can be adjusted within considerable limits by varying the proportion of oil and steam.

As applied at St. Albans there are 3 retorts in a setting, each 9 feet 9 inches long with a mouthpiece at each end, made of iron packed in fireclay, and packed with pieces of ordinary ¾-inch tubing, 6 feet 6 inches long. In section they are rectangular, 6 inches wide and 18 inches high. At one end is an injector for oil and superheated steam, and at the other an ascension pipe and hydraulic. The gas passes through a condenser and then to the holder, no purifying apparatus being required. The feed is continuous and the consumption of oil (solar distillate) is less than 3 gallons per 1,000 cubic feet of 16 candle gas. Each retort will make 250 to 300 cubic feet of gas per hour, containing about 45 per cent. of hydrogen, 7 per cent. of carbonic oxide, and calorific value 620 B.T.U. The iron tubes are oxidized by the steam and reduced by the oil vapors, and these two actions tend to maintain the *status quo*, no weight being added to the contents of the retort and nothing taken from it. The reactions that take place in the retort and the composition of the resulting gas afford some nice little studies in chemistry. One question that occurs to me is the ultimate disposal of the oxygen. Every 9 pounds of steam used means 8 pounds of oxygen, and if, as appears from the above figures, about 3 pounds of steam are used per gallon of oil, the resultant gas will contain nearly 25 per cent. by weight of oxygen, or say 7 per cent. by bulk. This would be equivalent to 14 per cent. of carbonic oxide, so if the proportion of that substance is correctly stated, oxygen must be present in some other form. As with the other processes the practical success of this method of gas making must turn upon the choice of raw material, whether there is an unlimited supply of solar distillate on the market, or failing that, whether the process can be utilized for a wide range of other distillates. A distillate is an artificial product and must therefore cost more than a natural product, and as there are no residuals it is difficult to see where the economy of the process as compared with ordinary coal gas comes in. The fuel account must necessarily be comparatively high.

This is the beginning of the big gooseberry season in gas circles, and one of the stories that turns up with amusing regularity every springtime is to the effect that one or more large gas coal contracts have been renewed on advanced terms, usually 6d. to 1s. a ton. The London companies, for some reason or other, are usually mentioned in this connection.

It is rather puzzling to know why any company, large or small, should close with advanced terms in March or April. There may be something in having a bird in the hand and it may be worth while to pay something for that security. Perhaps being secure in respect to a proportion of the requirement enables a bolder hand to be played in regard to the remainder. Sometimes it is a large railway company or shipping company that has followed a similar course, and in this connection, also, one wonders at the policy of stiffening the market at an early stage. The natural conclusion is that the sellers would at this period of the year be offering inducements and not the buyers. I have repeatedly noticed that, notwithstanning the circulation of statements of this character early in the year, the general trend of prices has been downward rather than upward, and the bulk of the contracts have been placed on better terms.

"J. S. S.," writing from Portland, Me., under date of the 21st inst., says: "The Maine Light, Heat and Power Company has been organized at Portland for the purpose of manufacturing and dealing in gas producing machines and for various other purposes, with $250,000 capital stock, of which $300 is paid in. Officers: President, Philip J. Deering, of Portland; Treasurer, Nathaniel M. Marshall, of Portland. Certificate approved April 17, 1906."

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

MR. B. F. BULLOCK has been appointed Superintendent of the City Gas Works, of Fredericksburg, Va., succeeding Mr. William Fitzpatrick who had served as Superintendent since 1890. Mr. Fitzpatrick's retirement is due to increasing years.

AT the annual meeting of the York (Pa.) Gas Company the following officers were elected: Board of Managers, George S. Billmeyer, John C. Schmidt, Henry Nes, George Small, Charles Keortz and E. K. McConkey; President, Grier Hirsh.

A CORRESPONDENT in Milwaukee, Wis., writing under date of the 20th inst., incloses the following: "Colonel Edward G. Pratt, for 3 years Vice-President and General Manager of the Milwaukee Gas Light Company, resigned at a meeting of the Directors held the 18th inst. He will go to Detroit to occupy similar positions with the Detroit Gas Company, which is controlled by the American Light and Traction Company, the same syndicate that owns the Milwaukee plant. Mr. Sheldon J. Glass, until 3 years ago Secretary of the Milwaukee Company, will succeed Col. Pratt in Milwaukee. Mr. Glass returns here from New York, where he has been Secretary and Treasurer of the syndicate Company. The changes will become effective May 1. Mr. James Lawrence, Assistant Secretary of the Eastern syndicate, will be advanced to succeed Mr. Glass. It is said that Emerson McMillin, President and Treasurer of the American Light and Traction Company, favors the idea of the rotation of managers and other officers under the general Company. Mr. A. P. Lathrop, whom Col. Pratt will succeed at Detroit, will be advanced to the positions of Vice-President and Treasurer of the parent Company in New York, Mr. McMillin relinquishing much of the active management of the big concern. Col. Pratt's change is in the nature of a promotion. Col. Pratt came to Milwaukee to succeed Mr. E. G. Cowdery, who was advanced to the Vice-Presidency and General Management of the Laclede Gas Light Company, of St. Louis; Col. Pratt coming from Des Moines, Ia., where he had been head of the Gas Company there. He says the appointment to the Detroit position came as a surprise to him and he regrets very much to leave Milwaukee. The new head of the Milwaukee concern, Mr. Glass, will aim to continue the business policy of Col. Pratt, under which the business here has grown and prospered. There probably will be no further changes in the personnel of the company here."

THE preferred stock of the Oberlin (O.) Gas and Electric Company has been put on a 6 per cent. basis.

WE understand that the plant and franchises of the Cambridge (Md.) Gas Light Company have been purchased by Mr. James Gamble and associates, of this city.

MR. OSCAR STOUCKE, for over 15 years in the employ of the Consumers Gas Company, of Reading, has resigned from its service. Ill health we are sorry to say, prompted the resignation.

THE gas plant to be erected at Shawnee, Col., is to be of the coal gas type. The main system covers 25 miles.

"THE Rochester (Ind.) Gas Company's plant will be completed by July 1st; so says Mr. William A. Martin, its President. The full executive management is: President, W. A. Martin; Vice-President, Edward F. Michael; Secretary, John Ott; Treasurer, Emmett Scott; General Manager, Frederick W. Freese.—A. F."

MR. J. T. SAFFLEY has been appointed assistant city gas inspector, vice Mr. E. M. Booker, in Kansas City, Mo.

THE plant at Garnett, Kas., was sold some days ago, under a foreclosure order. The purchaser was Mr. Joseph Carey, at his bid of $58,400.

THE owners of the Coldwater (Mich.) Gas Light and Fuel Company have purchased the plot known as the Firth property on Clay street in that city. It is likely that in a short time a new holder will be erected thereon, also a coke storage house. The property is a valuable one.

AT the annual meeting of the Framingham (Mass.) Gas, Fuel and Power Company, which was held in Boston some days ago, the of-

ficers elected were: President, John Joyce; Treasurer, Vincent Goldthwaite; Superintendent, F. W. Jennings. It was decided to extend the mains to Framingham Center.

MR. ARTHUR E. JACKMAN has resigned from the service of the Willimantic (Conn.) Gas and Electric Light Company, in order to assume the duties of General Manager of the Narragansett (R. I.) Electric Light Company.

THE correct list of the officers of the Guild of Gas Managers of New England is as follows—for the information we are indebted to Mr. Walter G. Africa, of Manchester, N. H.: President, Mr. John A. Coffin, Gloucester, Mass.; Vice-President, Mr. William E. McKay, Boston, Mass.; Treasurer, Mr. William A. Wood, Boston, Mass.; Secretary Mr. Walter G. Africa, Manchester, N. H.

THE authorities of Richmond, Va., have given an emphatic denial, and by official vote of Councils, to the report that the municipal gas works will be either leased or sold.

MR. FREDERIC EGNER, writing to us from Norfolk, Va., under date of the 20th inst., incloses the following: "Final transfers and details in the merger of all of the Williams and Middendorf interest—traction, gas and electric lighting properties—in Norfolk, Portsmouth, Berkley and Suffolk, Va., into the $14,000,000 merger or holding company backed by prominent ones in the United Gas Improvement Company, the succeeding concern in reality, were completed here to-day. Yesterday the Norfolk Railway and Light Company agreed to a lease of its properties to the Norfolk, Portsmouth and Newport News Company, for a term of 99 years, the price not being stated. To-day the stockholders of the Norfolk, Portsmouth and Newport News Company are meeting, and in addition to completing the transfer of the lease of the Norfolk Railway and Light properties, are making similar leases of all the other traction and lighting properties which are to be included in the merger, these leases taking over the securities, properties and franchises of the Old Dominion Railway Company, this being the original street car company in Portsmouth, and once owned by Philadelphia interests, the Berkley Street Railway Company, the Suffolk Light and Ice Company, and other affiliated properties."

AT the annual meeting of the Federal Gas Company, of Boulder, Col., the officers elected were: President, A. J. Macky; Vice-President, T. V. Wilson; Secretary, John Mossman. The reports showed that the Company enjoyed a prosperous year, and the opinion was that a dividend would be paid within the twelvemonth.

ADVICES by way of New Orleans, under date of the 18th inst. are to this effect: "Mr. L. J. Davis, General Manager of the Electric Lighting Company, of Mobile, Ala., and representing Northern capitalists who recently secured the interests of that Company and the Mobile Gas Light and Coke Company, announced to-day the severance of the two interests by the sale of the former concern to H. M. Byllesby & Company, large operators of electrical properties of Chicago and elsewhere. The sale was consummated a few days ago at Chicago. The gas and coke interest is retained and will be conducted under the management of Mr. Rufus C. Dawes of Chicago, the President of the Company, and principal owner. Hon. John Allen of Tupelo, Miss., is among the stockholders. Mr. Byllesby, A. E. Smith, J. J. O'Brien and other financiers, who have acquired the electric lighting interests, have been in the city for the past few days completing details in connection with vast improvements which are to be made to the plant and service in general. New machinery, which will increase the capacity of the plant sufficient to supply a city of 150,000 inhabitants, has already been ordered and in transit. S. C. Shaffner, who was Superintendent of the old concerns, has been retained and is given a prominent executive position. According to the statement of Mr. Davis the plant of the Coke Company is to be rebuilt entirely, and the capacity increased to meet the growth of the city for 20 years to come. The system of service is also to be rebuilt and many other improvements made. These improvements are to be carried out to completion as rapidly as possible. Contract is to be let by Byllesby & Company for a handsame office to be erected in the business district. It was stated that the estimated amount to be expended on improvements to the properties of the two Companies is $350,000. During the period of reconstruction of the electric lighting system the syndicate is to be represented here by C. E. Groesbeck, a well-known constructing engineer, who has being identified with the syndicate for a number of years."

Armature Losses.

The London correspondent of *Electricity* notes that at a meeting of the Newcastle Section of the Institution of Electrical Engineers, Dr. W. M. Thornton read a paper on "The Distribution of Magnetic Induction and Hysteresis Loss in Armatures," in which he described some experimental research concerning toothed core armatures. He stated that the study of magnetic distribution in armatures and poles is important for several reasons. The source of incidence of copper loss is now very well known, but this cannot be said with equal truth of the iron loss, whether it occurs by eddy currents or hysteresis. The success or failure of commutation depends on the induction in the teeth and outer layers of the core; hysteresis and eddy current losses depend equally upon the distribution in the deeper parts. Economy of material and reduction of weight require that the radical depth of the core should be as small as possible, whilst, on the other hand, if it is made too small, the full magnetism cannot enter and the leakage coefficient increases. The factors in the problem are the proportions and permeabilities of core, teeth and poles, the ratio of peripheral pole face to pole pitch, the length of the air gap and the flux density in it.

So many variables make any attempt at direct calculation of distribution of little value, but experimental investigation is aided by the fact that magnetic laws are precisely the same in a model of small dimensions as in a large machine, and in the second place, that it is only necessary to observe the distribution within one V-shaped sector included between two pole center lines.

Dr. Thornton summarized the result of a preliminary examination of the simplest case of a solid smooth-core armature thus: (1) The flux densities through a section of the core midway between the poles are in no case uniform, reaching a maximum at a short distance within and falling both towards the center and circumference; (2) the internal distribution is practically the same with long and short air gaps, though the leakage varies; (3) the ratio of the maximum density in the core to that in the gap is greatest when the pole pitch is small; (4) the variation of magnetization in passing from one pole to the next is widely different at different depths, so that hysteresis and eddy current losses are still more unevenly distributed.

Dr. Thornton's examination of the cases of toothed cores, hollow and solid, was made by a method using search coils wound in small holes drilled through the core parallel to the shaft. When the magnetizing circuit was made or broken, the inductive change through each of these in turn was observed by means of a ballistic galvanometer to avoid the disturbing effect of residual magnetism, a powerful alternating current was passed through the field winding before each reading was taken. His results may be summarized as follows: The magnetization of the teeth in slotted armatures is not alternating, but rotating, and at the same time fluctuating; that of the core is rotating, but by reason of the distribution of density in the core not being uniform, it is unevenly distributed, being greatest at the outer parts below the teeth. The ratio of the mean dissipation co-efficient to that corresponding to the mean density is about .8. The co-efficient for the teeth alone is about .00105 joule per cubic centimeter per cycle; that for the core .00108. The low value for the teeth is caused by the drop in density between the poles and by the fact that it is rotating.

The Welsbach Gas Lighting Appliance.

The *Gas World* says that it has been frequently alleged that the metals of the rare earths, when scratched by a hard, sharp substance in air, emit sparks; but it seems that this is not true of the pure metals, though it is true of their alloys, particularly with iron. Even with a small percentage of iron this property begins to manifest itself, and at 30 per cent. of iron it comes to a maximum. The alloy is then very resistant to air, and is very hard and brittle. The property of producing sparks dies away as the percent age of iron increases, and vanishes when it goes beyond 75. At 30 per cent. of iron, however, almost the least touch with a file is enough to make the alloy emit torrents of sparks; and this has been utilized in a contrivance in which the turning of the stopcock causes the production of sparks which kindle the gas.

Cerium is even better than thorium in this particular, while with lanthanium the sparks are particularly brilliant and luminous. For sparks for the purpose of kindling gas, 60 cerium, 10 of other rare earth metals, and 30 of iron, make a very successful alloy. The matter is being worked out, under Baron von Welsbach, at the Dr. Auer von Welsbach works, Treibach in Kärnten, Austria, which according to the *Journal für Gasbeleuchtung*, are prepared to give further information to those interested, and to supply sample pieces of the alloys.

THE AMERICAN GAS LIGHT JOURNAL

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PROPRIETORS.

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ELBERT P. CALLENDER,
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NOTIFICATION RESPECTING ADVERTISING.

Orders for new advertising, or for changes in standing advertisements, to insure attention in the issue following their reception, must be in hand any time of Wednesday.

AGENTS:

New York—American News Co., 39 and 41 Chambers St
Germany—Lemcke & Buechner, of New York.
England—Aug. Siegel, 30 Lime Street, London.

MONDAY, APRIL 30, 1906.

The Market for Gas Securities

The people in control of the Consolidated Gas Company yesterday (Thursday) cut the dividend rate to 1 per cent., and those who own the stock will not be greatly enriched by the act. The queer thing about it, however, is that those closest to the best sources of information are "absorbing" the stock, even though its closing to-day (Friday) was 131½ to 132. We do not believe that the 4 per cent. rate will last long, remembering that some years ago, in the midst of fierce competition, the Company paid 4 per cent. on a selling price of 65 cents. The doctors, though, are the ones who should administer the medicine.

Brookly Union is quoted at 118 to 120. The balance of the list, including Peoples of Chicago, is weak, no doubt being influenced by the disaster in San Francisco, respecting which at this writing we have no reliable advices, save that the gas works were badly damaged. The electric lighting division of the property seems to have escaped with comparatively small loss.

Gas Stocks.

Quotations by George W. Close, Broker and Dealer in Gas Stocks.

16 WALL STREET, NEW YORK CITY.

APRIL 23.

☞ All communications will receive particular attention.

☞ The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$73,177,000	100	131¾	132
Central Union, Bonds, 5's	3,000,000	1,000	108	110
Equitable Bonds, 6's	1,000,000	1,000	..	105
" 1st Con. 5's	2,300,000	1 000	118	120
Mutual	3,500,000	100	255	270
Municipal Bonds	75	..	..	..
New Amsterdam Gas Co.. Bonds, 5's	11,000,000	1,000	105	107
New York & Richmond Gas Co. (Staten Island)	1,500,000	100	37	43
1st Mtg. Gold Bds. 5 p. ct.	1,000,000	..	98	104
Northern Union, Bonds, 5's	1,250,000	1,000	106	107
New York and East River.. Bonds 1st 5's	3,500,000	1,000	108	111
" 1st Con. 5's	1,500,000	..	104	110
Standard	5,000,000	100	140	160
Preferred	5,000,000	100	155	175
Bonds, 1st Mortgage, 5's	1,500,000	1,000	111	114
Yonkers	299,650	500	130	..
Out-of-Town Companies.				
Brooklyn Union	15,000,000	100	118	120
" " Bonds (5's)	15 000,000	1,000	112	113
Bay State	50,000,000	50	5 5/16	¾
" Income Bonds	2,000,000	1,000	..	75
Binghamton Gas Works	450,000	100	..	65
" 1st Mtg. 5's	509,000	1,000	95	100
Boston United Gas Co.— 1st Series S. F. Trust	7,000,000	1,000	82	85
2d " " "	3,000,000	1,000	47½	50
Buffalo City Gas Co.	5,500,000	100	9	10
" " Bonds, 5's	5,250,000	1,000	75	80
Capital, Sacramento	500,000	50	..	35
Bonds (5's)	150,000	1,000	..	..
Chicago Gas Co. Guaranteed Gold Bonds	7,650,000	1,000	104	106¾
Cincinnati Gas and Electric Co.	29,500,000	100	102½	102¾
Columbus (O.) Gas Co., 1st Mortgage Bonds	1,500,000	1,000	90	..
Columbus (O.) Gas Lt. & Heating Co	1,682,750	100	..	95
Preferred	3,026,500	100	107½	108
Consumers, Toronto	,000,000	50	200	204
Consolidated, Baltimore	11,000,000	100	..	86
Mortgage, 6's	3,600,000	..	..	118
Chesapeake, 1st 6's	1,000,000	..	..	..
Equitable, 1st 6's	910,000	..	..	..
Consolidated, 1st 5's	1,490 000	..	..	112
Consolidated Gas Co. of N. J.	1,000,000	100	15	17
" Con. Mtg. 5's	880,000	1,000	92	95
Bonds	75,000	..	..	100
Detroit City Gas Co	5,000,000	50	..	50
" Prior Lien 5's	4,618,000	1,000	..	98
Detroit Gas Co., 5's	351,000	1,000	75	80
" Inc. 5's	16,000	100	98¾	100
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Essex and Hudson Gas Co.	6,500,000	..	39	40
Fort Wayne	2,000,000	..	..	..
" Bonds	2,000,000	..	55	..
Grand Rapids Gas Lt. Co. 1st Mtg. 5's	1,225,000	1,000	104½	105
Hartford	750,000	25	190	200
Hudson County Gas Co., of New Jersey	10,500,000	..	110	112
" Bonds, 5's	10,500,000	..	107½	108½
Indianapolis	2,000,000	..	60	70
" Bonds, 5's	2,650,000	..	104½	105
Jackson Gas Co	250,000	50	82	..
" 1st Mtg. 5's	290,000	1,000	97	100
Kansas City Gas Light Co., of Missouri	5,000,000	100	..	36
Bonds, 1st 5's	3,822,000	1,000	102	104
Laclede, St. Louis	10,000,000	100		105
Preferred	2,500,000	100	95	110
Bonds	10,000,000	1,000	108¼	109
Lafayette Gas Co., Ind.	1,000,000	100	..	60
Bonds	1,000,000	1,000	60	65
Louisville	2,570,000	50	143	145
Madison Gas & Elec. Co. " 1st Mtg. 6's	350,000	1,000	106	108¾
" 6 per cent. scrip, due 1910	100,000	25	85	87
Montreal, Canada	3,000,000	100	218	218¾
Nashville Gas Lt. Co.	1,000,000	100	110	..
Newark, N. J., Con. Gas Co.	6,000,000	..	56	58
Bonds, 6's	6,000,000	..	137	138
New Haven	2,000,000	25	200	..
Peoples G. L. & Coke Co., of Chicago	25,000,000	100	90	90¼
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage	20,100,000	1,000	..	..
2d "	2,500,000	1,000	104	..
Rochester Gas & Elec. Co.	2,150,000	50	88	..
Preferred	2,150,000	50	118	..
Consolidated 5's	2,000,000	..	104½	105¼
San Francisco, Cal.	15,800,000	100	..	..
St. Joseph Gas Co. " 1st Mtg. 5's	751,000	1,000	92	..
St. Paul Gas Light Co	1,500,000	100	45	47
1st Mortgage 6's	650,000	1,000	113	116
Extension, 6's	600,000	1,000	112½	115
General Mortgage, 5's	2,465,000	1,000	96¼	..
Syracuse, N. Y.	1,975,000	100	50	55
Bonds	2,047 000	1,000	102	..
Washington, D. C	2,500,000	20	298¾	299¾
First mortgage 6's	500,000	..	..	..
Western, Milwaukee	4,000,000	..	..	..
Wilmington, Del	600,000	50	230	..

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(Continued on page 765.)

SPECIAL NOTICE.

OFFICE OF THE UNITED GAS IMPROVEMENT CO.,
N. W. CORNER BROAD AND ARCH STS.,
PHILADELPHIA, February 14, 1906.

The Annual Meeting of the Stockholders of The United Gas Improvement Company will be held at the office of the Company, Northwest Corner of BROAD AND ARCH STREETS, PHILADELPHIA, on Monday, May 7, 1906, at 12 o'clock, noon, for the purpose of electing a President and six Directors, to serve for the ensuing year, considering and acting upon the subject of a proposed increase in the capital stock of the company from 734,500 shares of the par value of $50 each, to 918,005 shares of the par value of $50 each, and transacting such other business as may properly come before the meeting. The stock transfer books will be closed from 3 P.M., April 25, until 9 A.M., May 8th, 1906.

By order of the Board of Directors.

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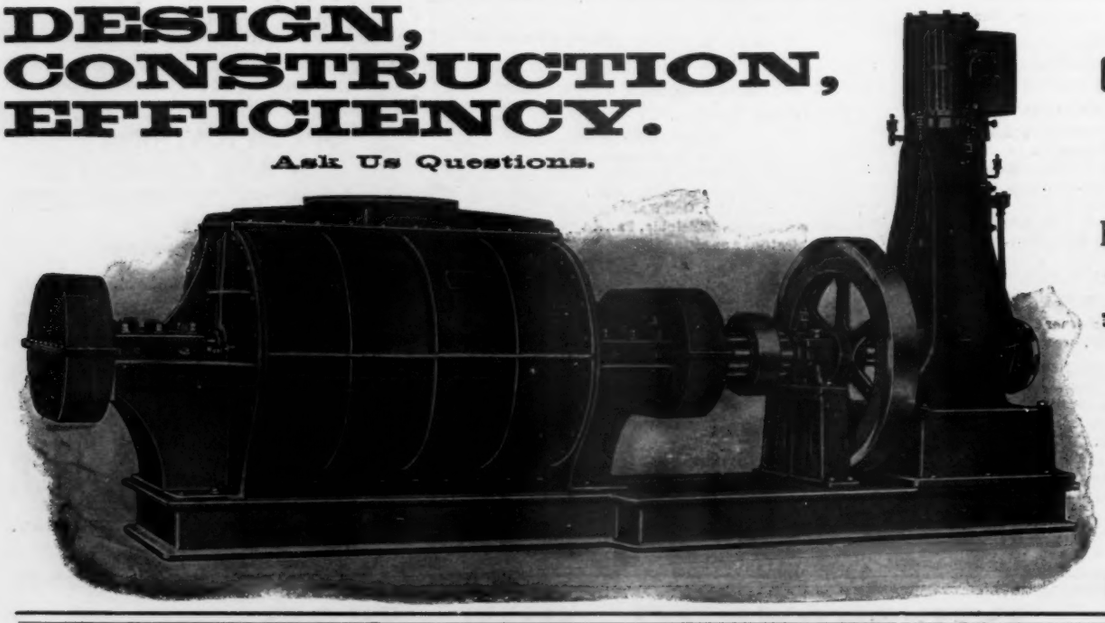

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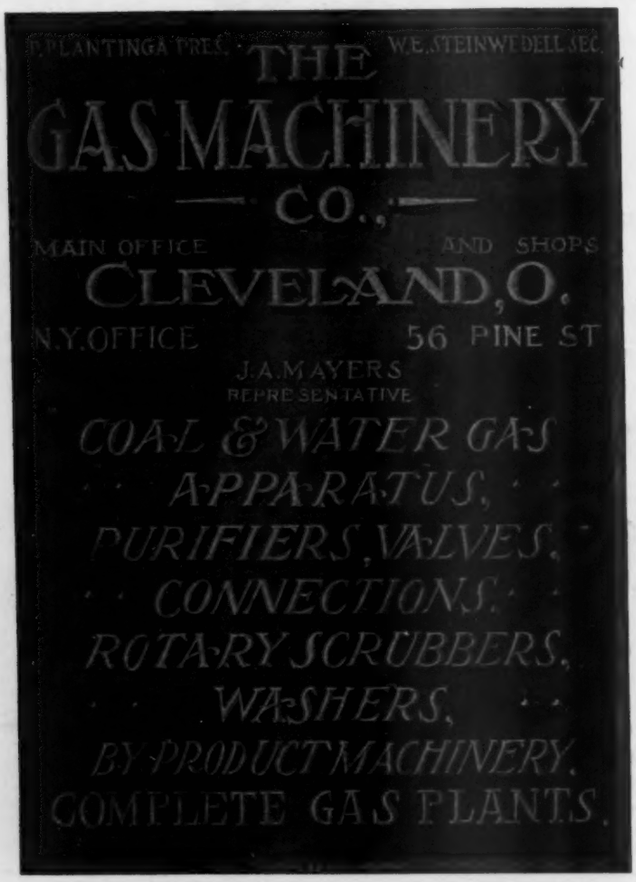

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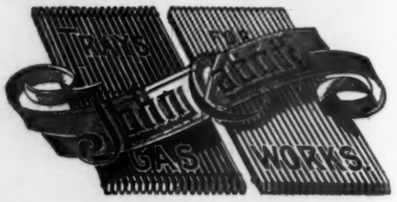

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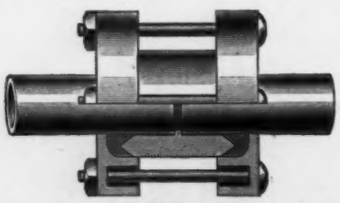
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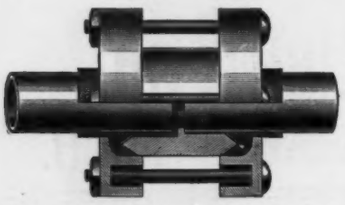
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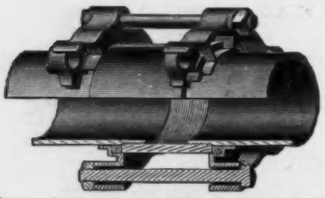
Clamp, Style 4, for Repairing Leaks on Screw Collar.

Long Sleeve, Style 2, for Mending Broken Lines.

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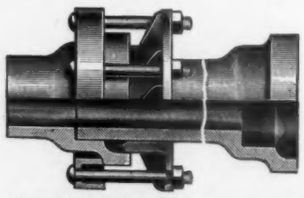
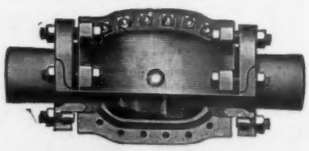
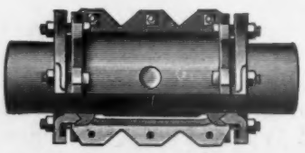
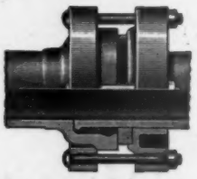

Coupling, Style 9, for Special Style Cast Iron Pipe.


Split Sleeve for Repairing Broken Bell on Cast Iron Pipe.


Split Sleeve for Repairing Broken or Cracked Cast Iron Pipe.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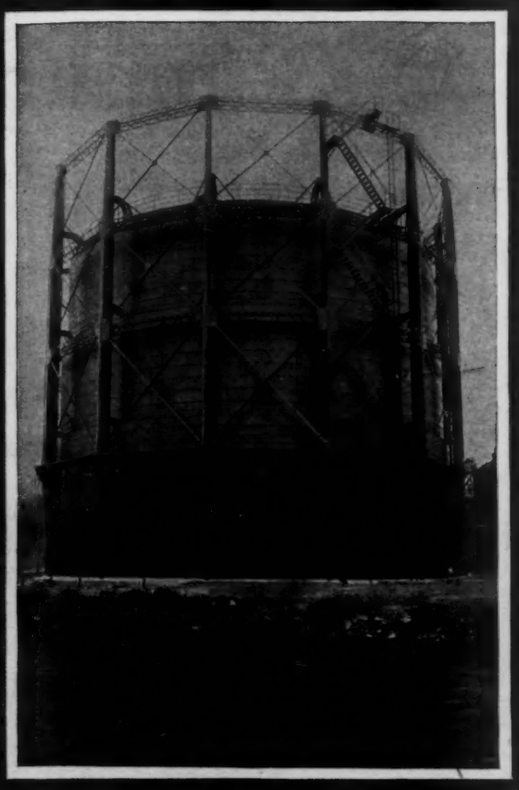

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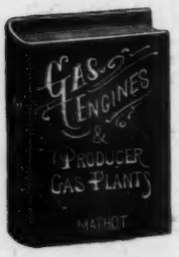

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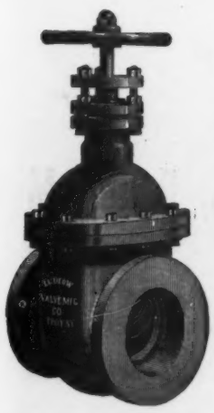

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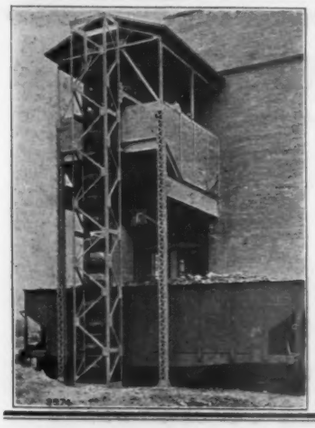

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L = length of pipe in miles,
w = specific gravity of the fluid when air = 1.

To Find the Discharge from a Pipe and the Required Size of Pipe.

(1.) Set the specific gravity of the fluid opposite the length of pipe;

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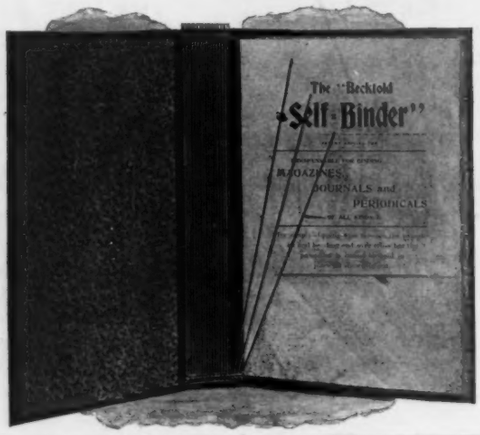

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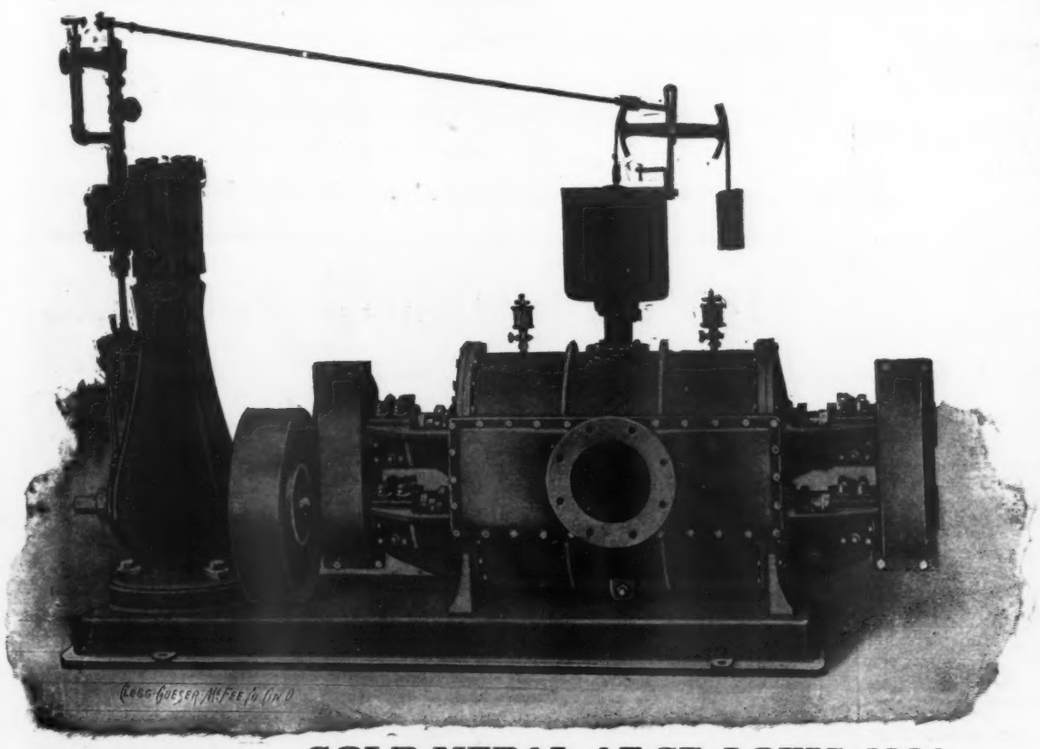

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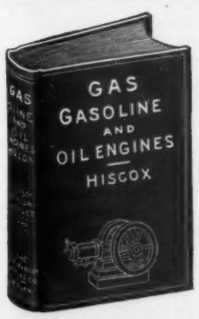

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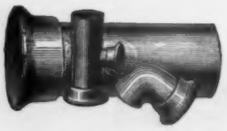

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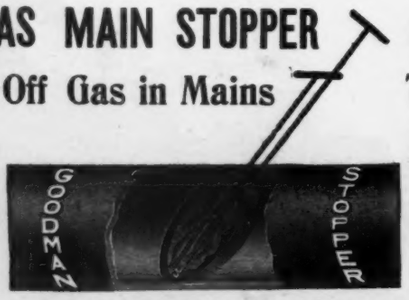

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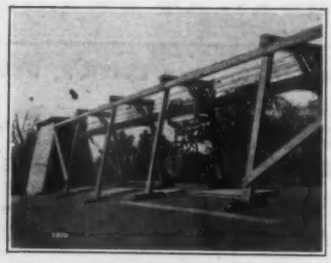

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PUBLIC LIGHTING TABLE.

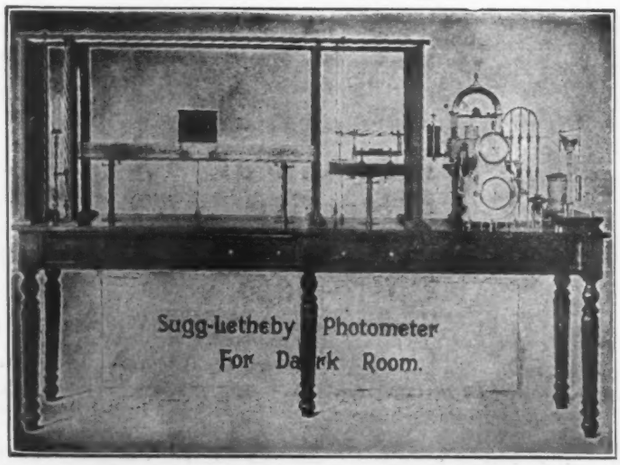
MAY, 1906.

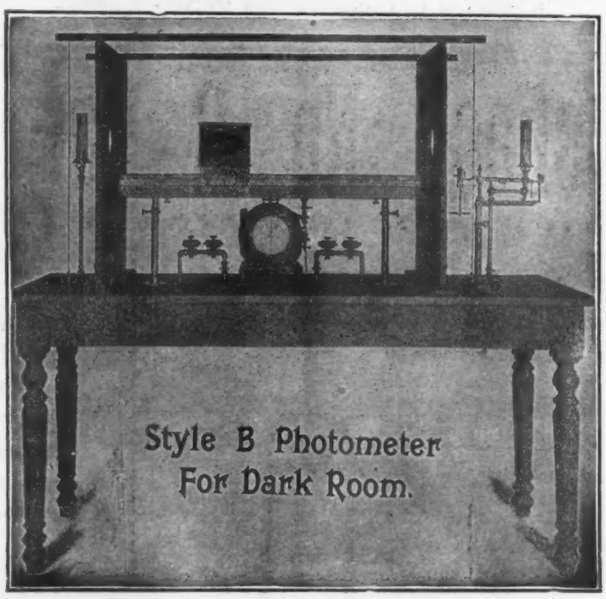
Day of Week.	Table No. 1. FOLLOWING THE MOON. Date.	Light.	Extinguish.
Tue.	1	12.30 AM FQ	4.00 AM
Wed.	2	1.10	4.00
Thu.	3	1.50	4.00
Fri.	4	2.20	4.00
Sat.	5	3.00	4.00
Sun.	6	3.30	3.50
Mon.	7	No L.	No L.
Tue.	8	No L. FM	No L.
Wed.	9	No L.	No L.
Thu.	10	7.30 PM	10.40 PM
Fri.	11	7.30	11.40
Sat.	12	7.30	12.40 AM
Sun.	13	7.40	1.20
Mon.	14	7.40 LQ	2.00
Tue.	15	7.40	2.40
Wed.	16	7.40	3.10
Thu.	17	7.40	3.40
Fri.	18	7.40	3.40
Sat.	19	7.40	3.40
Sun	20	7.40	3.40
Mon.	21	7.40	3.40
Tue.	22	7.40 NM	3.40
Wed.	23	7.40	3.40
Thu.	24	7.40	3.40
Fri.	25	7.40	3.40
Sat.	26	7.40	3.40
Sun.	27	9.50	3.30
Mon.	28	10.30	3.30
Tue.	29	11.10	3.30
Wed.	30	11.50 FQ	3.30
Thu.	31	12.20 AM	3.30

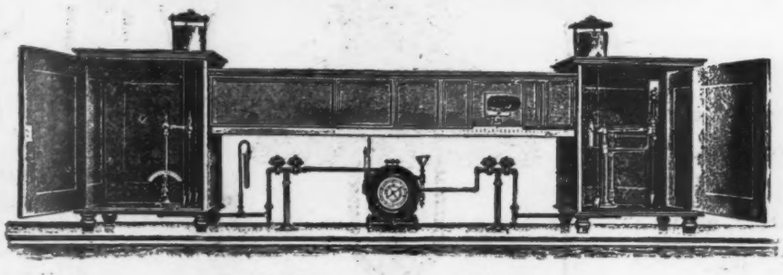
TOTAL HOURS DURING 1906.

By Table No. 1.

	Hrs.Min.
January	223.40
February	190.40
March	192.10
April	167.00
May	152.20
June	142.10
July	150.20
August	157.40
September	170.00
October	185.10
November	201.40
December	214.00
Total, yr.	2146.50







Closed Photometer For Light Room.

CIRCULARS SENT ON REQUEST.

PUBLIC LIGHTING TABLE.

MAY, 1906.

Day of Week.	Table No. 2. NEW YORK CITY. All Night Lighting. Date.	Light	Extinguish.
		P. M.	A.M.
Tue.	1	6.45	4.00
Wed.	2	6.45	4.00
Thu.	3	6.45	4.00
Fri.	4	6.45	4.00
Sat.	5	6.45	4.00
Sun.	6	6.45	4.00
Mon.	7	6.55	3.40
Tue.	8	6.55	3.40
Wed.	9	6.55	3.40
Thu.	10	6.55	3.40
Fri.	11	6.55	3.40
Sat.	12	6.55	3.40
Sun.	13	6.55	3.40
Mon.	14	7.00	3.30
Tue.	15	7.00	3.30
Wed.	16	7.00	3.30
Thu.	17	7.00	3.30
Fri.	18	7.00	3.30
Sat.	19	7.00	3.30
Sun.	20	7.00	3.30
Mon.	21	7.10	3.15
Tue.	22	7.10	3.15
Wed.	23	7.10	3.15
Thu.	24	7.10	3.15
Fri.	25	7.10	3.15
Sat.	26	7.10	3.15
Sun.	27	7.10	3.15
Mon.	28	7.15	3.15
Tue.	29	7.15	3.15
Wed.	30	7.15	3.15
Thu.	31	7.15	3.15

TOTAL HOURS DURING 1906.

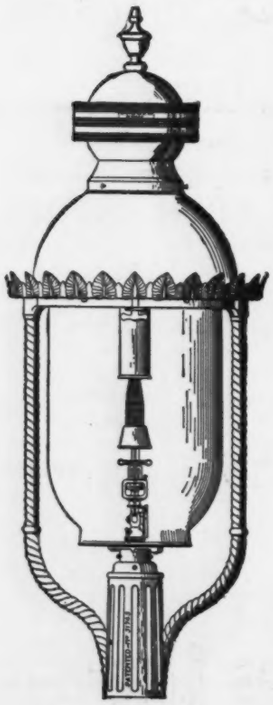
By Table No. 2.

	Hrs.Min.
January	423.20
February	355.25
March	355.35
April	298.50
May	264.50
June	234.25
July	243.45
August	280.25
September	321.15
October	374.30
November	401.40
December	433.45
Total, yr.	3987.45

NEW YORK, 318 West 42d Street. BOSTON, 820 Beacon Building. PHILADELPHIA, Broad and Arch Streets. ST. LOUIS, 712 Roe Building. CHICAGO, 218 La Salle Street. SAN FRANCISCO, 712 Polk Street.

WELSBACH STREET LIGHTING COMPANY

.... OF AMERICA ....



No. 36.

Controls and Operates the

Welsbach System of Street Lighting,

Which includes its specially DESIGNED AND PATENTED BURNER for STREET and PARK LIGHTING exclusively.

Uniformly SUCCESSFUL in 150 Cities and Towns.

By means of the Welsbach System of street lighting the superiority of GAS over electricity for street lighting has been fully demonstrated.

POINTS OF MERIT:

It is { Economical, Attractive, Successful, Up-to-date.

IT LIGHTS THE STREET.

Where there are no gas mains we can furnish an equally good light by our SELF-GENERATING NAPHTHA WELSBACH BURNER, and thereby supply a uniform light in all localities.

Correspondence Solicited from Gas Companies and Others interested in Municipal and Outside Lighting.

No. 38.

The Welsbach No. 6 Harp Fixture.

AN IDEAL LIGHT FOR DINING OR LIVING ROOMS.

THE HIGHEST MECHANICAL INGENUITY COMBINED WITH ORNAMENTAL BEAUTY--THE NEWEST OUTPUT FROM THE WELSBACH FACTORIES.

Equipped with new model No. 66 high candle power Welsbach Burner.

Side Pilot By-pass Tube covered with refractory sleeve to prevent bending.

Fourteen-inch Opal Dome Shade.

Polished Brass Embossed Crown 2¼ inches high.

Length of Fixture, 30 inches.

Width of Harp, 4½ inches.

Finished in Polished Brass.

Packed One Dozen to the Case.

List Price, per Dozen, $45 00.

We recommend equipping the No. 6 Harp Fixture with No. 4197 Intensive Brand Mantle, and the No. 306 **F. Q. M.** Clear Glass Air-Hole Cylinder.

Although the 14-inch Opal Dome Shade is standard equipment, we are prepared to furnish Dome Shades in green, pink or yellow (opal lined), and will be glad to quote prices.

WELSBACH CO.,

Salesrooms in all the principal cities of the United States.

Factories:

GLOUCESTER, N. J.
CHICAGO, ILL.

THE UNITED GAS IMPROVEMENT COMPANY

For the Year Ending December 31st, 1905, has been Awarded Contracts for 40 Sets of

Standard Double-Superheater Lowe Water Gas Apparatus.

PARTIAL LIST OF PLACES:

Catasauqua, Pa.
Plattsmouth, Neb.
Detroit, Mich. (2d contract).
Springfield, Ills.
Oneonta, N. Y. (2d contract).
Pottsville, Pa. (2d contract).
Evansville, Ind. (2d contract).
Lansdale, Pa.
Hempstead, N. Y. (2d contract).
New Britain, Conn.
New York, Mutual Co. (3d contract)
St. Louis, Mo. (4th contract).
Sioux City, Ia. (3d contract).
Amsterdam, N. Y.
Houston, Tex. (2d contract).
Hamilton, O. (2d contract).
Indianapolis, Ind. (2d contract).
Nanticoke, Pa.
Hazleton, Pa.
Mahanoy City, Pa.
Ludington, Mich.
Ossining, N. Y.
Lancaster, Pa.
Flushing, N. Y. (2d contract).
South Bend, Ind.
Fall River, Mass. (2d contract).
Minneapolis, Minn. (2d contract).

TOTAL SETS TO DECEMBER 31, 1905, ... 593
TOTAL DAILY CAPACITY TO DECEMBER 31, 1905, 463,780,000 CU. FT.

The United Gas Improvement Company,

Broad and Arch Streets, Philadelphia.

Established 1858. Incorporated 1890.
CHAS. E. GREGORY, Prest. DAVID R. DALY, V.-Prest. & Treas.
H. D. ABERNETHY, Sec.

J. H. Gautier & Co.

Greene & Essex Streets,
Jersey City, N. J.

MANUFACTURERS OF

CLAY GAS RETORTS, FIRE CLAY TILES, FIRE BRICK and FIRE CLAY SPECIALTIES.

Ground Fire Clay, Fire Sand and Ground Fire Brick in Barrels and Bulk.

SOLE MANUFACTURERS OF THE

FLEMMING ENERATOR GAS FURNACE

Brooklyn Fire Brick Works,

OFFICE AND WORKS:
88 VAN DYKE ST., BROOKLYN, N. Y.
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CLAY GAS RETORTS & SETTINGS, GENERATOR LININGS. SPECIALTIES.

ST. LOUIS GAS CONSTRUCTION CO.,

DESIGNERS AND BUILDERS OF

COAL GAS BENCHES,

SPECIAL HIGH GRADE REFRACTORY MATERIAL FOR BENCH SETTINGS AND WATER GAS LININGS.

SOLE AGENTS FOR

CHRISTY SETTINGS.

CORRESPONDENCE SOLICITED.

ST. LOUIS, MO.

STANLEY'S CELEBRATED FIRE CEMENT

For the Repair of Clay and Iron Retorts & Firebrick Work, for the Protection of Ironwork when Exposed to a High Degree of Heat, and Excellent for Mouthpiece Joints.

In General Use in the United States and Canada.
Unlike Expensive Preparations,
THERE IS ABSOLUTELY NO WASTE.
F. W. STANLEY,
150 Nassau St., New York, N. Y.

ALBERT J. WEBER, President and General Manager.
Established 1846.

Adam Weber Sons.

Manhattan Fire Brick and Enameled Fire Clay Retort Works.

Works at Weber, on the Raritan River. Middlesex County, New Jersey.
GENERAL OFFICES:
Park Row Building, New York City.

Modern Coal Gas Benches,

With either Horizontal or Inclined Retorts, Half-Depth and Full-Depth Recuperative Furnaces.

ADAM WEBER PATENTS

STANDARD BENCH IRONWORK.

Linings for Water Gas Apparatus, High Grade Fire Brick of All Shapes and Sizes, Ground Fire Clay, Ground Fire Brick in Bulk or in Barrels.

ISAAC G. BAXTER, President.
Works,
LOCKPORT STATION, PA.

ESTABLISHED 1864.

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Successor to WILLIAM GARDNER & SON.

PETER YOUNG, Secretary and Treas.
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Fire Clay Goods for Gas Works.

HENRY MAURER & SON,

(ESTABLISHED 1856.)

EXCELSIOR FIRE BRICK & CLAY

RETORT WORKS

WORKS, Perth Amboy, N. J.
OFFICE, 418 to 422 East 23d St., N. Y.

Clay Gas Retorts,

BENCH SETTINGS,

Fire Brick, Tiles, Etc.

GEROULD'S IMPROVED RETORT CEMENT.

A Cement of great value for patching retorts, putting on mouthpieces, making up all bench-work joints, lining blast furnaces and cupolas. This cement is mixed ready for use. Economic and thorough in its work. Fully warranted to stick.

Price List, f.o.b. PITTSBURGH, PA.
In Casks, 400 to 800 pounds, at 5 cents per pound.
In Kegs, 100 to 200 " " 6 " "
In Kegs less than 100 " " 7 " "

C. L. GEROULD,
1200 Bank for Savings Bldg., Pittsburgh, Pa.

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MANUFACTURERS OF

Fire Brick, Tiles, Special Shapes, etc.

NEW YORK OFFICE:
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South River, N. J.

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BALTIMORE, MD.,

Manufacturers of all Material for the Construction of Coal Gas Benches.

HALF AND FULL DEPTH AND FREE FIRING BENCHES,

All styles of which we have in operation, equipped with the BEST of LATEST IMPROVEMENTS, proving our claim for SUPERIOR QUALITY and EFFICIENCY.

INCLINES—We have in SUCCESSFUL OPERATION benches of Inclined Retorts, MANUFACTURED and ERECTED by us.

WALDO BROS., 102 MILK ST., BOSTON, MASS.,
Agents for New England States.

LARGE FACILITIES—Correspondence Solicited.
RAIL and WATER CONNECTIONS to ALL POINTS.

JOHN DELL,
President and General Manager.

MISSOURI FIRE BRICK CO.,

ESTABLISHED 1882.

MANUFACTURERS OF

Gas Retorts, Bench Settings, Fire Brick, Cupola Linings, Etc.

We are the **Exclusive Agents** *for the* **Mitchell Patent Benches,** *Constructed with Half or Full Depth Furnaces, to Burn either Coal or Coke, and Arranged for Front or* **Rear Clinkering.** *The* **Mitchell** *is the* **Original Coal Firing Bench.** *We also Erect Plain Benches with* **One to Six Retorts.**

YOUR CORRESPONDENCE IS RESPECTFULLY SOLICITED.

City Office: *411 Olive Street, Continental Bank,* ST. LOUIS, MO.

Bronder Patent Stoking Machinery.

Three-Scoop and Three-Rake Charging and Discharging Machines are operating in New York, Newark, N. J., Philadelphia, Worcester, Mass., Mt. Vernon, N. Y., Toronto and Montreal, Canada.

Four-Scoop and Four-Rake Charging and Discharging Machines are operating in Detroit, Mich.

These are the only machines that will draw or charge simultaneously 3 or 4 retorts (vertically) and handle from 42 to 60 retorts in from 25 to 30 minutes, lid opening and closing and filling of furnaces included.

Hot Coke Conveyor, Quencher and Steam Exhauster, operating in Toronto, Canada, working in water-sealed flue, rollers being protected from heat and grit.

COAL CRUSHERS, CONVEYORS AND BINS. TURNTABLES FOR MACHINES.

Labor-Saving Machines for Handling Coal and Coke from Coal Cars to Coke Yard or Bins, a Specialty.

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Contracting Engineer and Builder,

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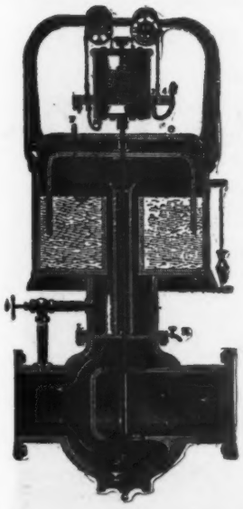

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COAL OR WATER GAS PLANTS,

Automatic, Balance, High Pressure and Service Governors,

Roots Improved Gas Exhausters,

Iron Sponge, Purifying Material for Gas Purification, Jones Jet Photometers, Pressure Registers, etc.,

INSTALLATION OF SMOKELESS TAR BURNING SYSTEM.

Reinforced Concrete Construction for all Purposes,

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OF ST. LOUIS, MO.,

PROPRIETORS OF THE

OAK HILL GAS RETORT AND FIREBRICK WORKS.

ST. LOUIS OFFICE: 417 Pine Street. **NEW YORK OFFICE: Aldrich Court, 45 Broadway.**

WE MAKE A SPECIALTY OF WATER GAS LININGS AND CHECKER BRICK.

Half and Full Depth Benches of Our Own Design, Containing 6, 8 or 9 Retorts.

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We Build Benches Complete. Ready for Gas Making. Also,

RETORT HOUSES,

COAL and COKE CONVEYING MACHINERY.

Plans, Specifications and Estimates Cheerfully Furnished.

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ALL CONTRACTS MADE AS OF ST. LOUIS, MO.

Gold Medals awarded by the Louisiana Purchase Exposition at St. Louis, for fireclay gas retorts, gas retort benches, firebrick and setting tiles.

Newbigging's Handbook for Gas Engineers and Managers. **Price, $6.50.** For Sale by A. M. Callender & Co., 42 Pine St., N. Y. City.

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228 and 229 Produce Exchange, New York City.

Ocean Mine Youghiogheny Gas Coal,
Old Kentucky Shale and O. K. Boghead.

SHIPMENTS FROM NEW YORK, PHILADELPHIA, BALTIMORE AND NORFOLK.

BERWIND-WHITE COAL MINING COMPANY'S

Ocean Westmoreland Gas Coal.

Offices:
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STRICTLY High Grade. . . . .
Carefully Prepared.
For Gas Making or
Heavy Steaming. .

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ARE INCLUDED IN OUR
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Inclined Benches, own system, Recuperative Furnaces, Exhausters, Exhauster Governors, Condensers, Washers, Coolers, Wet Purifying Plants, Purifiers, Oxide Elevators, Hydraulic and Dry Coke Conveyors.

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KELLER ADJUSTABLE COKE CRUSHER.

Strong, Simple, Durable. Will Crush any Size Desired.

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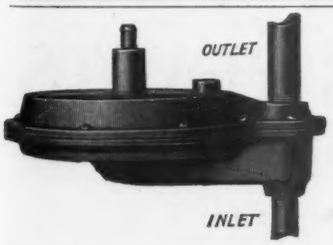

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Our Governors Reduce 30 or 40 Pounds Pressure to 2 Inches Water Pressure.

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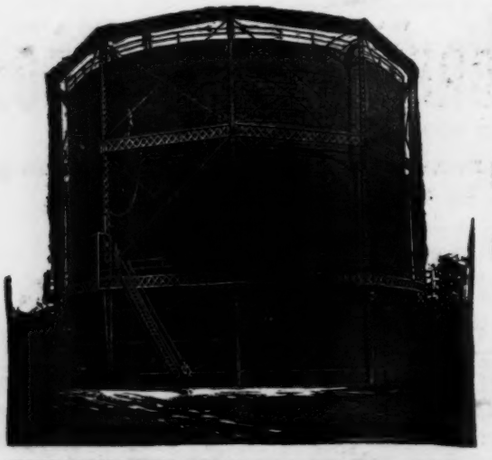

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Single, Double and Triple-Lift Gasholders of any Capacity. Tubular, Pipe and Sinuous Friction Condensers of all Sizes.

Steel Tanks for Gasholders, Iron Roof Frames and Floors, Purifying Boxes, Center Seal or Valve Connections, Bench Work, Reversible Lime Trays.

Self-Sealing and Pressed Steel Mouthpiece Lids.

Coke Barrows, Coal Wagons, and all Apparatus Requisite for a Complete Gas Works.

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SINGLE AND DOUBLE-LIFT GASHOLDERS AND STEEL TANKS,
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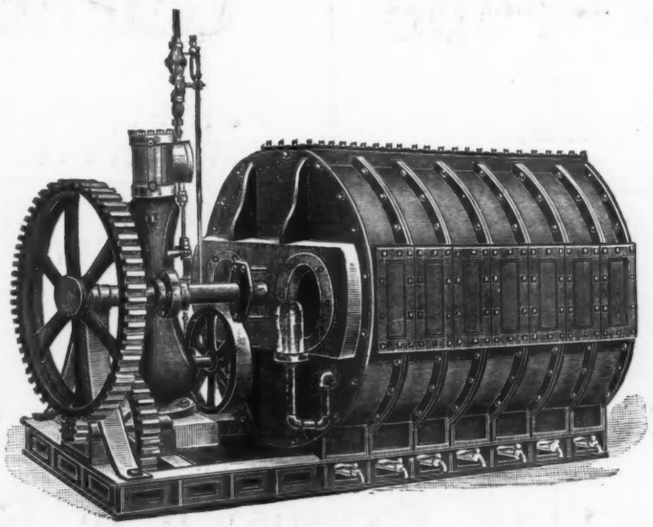

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The best apparatus for the extraction of all Ammonia and a large proportion of Carbonic Acid and Sulphureted Hydrogen. The Scrubber has been materially improved and is provided with patented Wooden Segmental Grids, instead of Metallic Disks, thus reducing the weight on shaft and power for operating same.

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TOTAL WALKER TYPE TAR EXTRACTORS SOLD:

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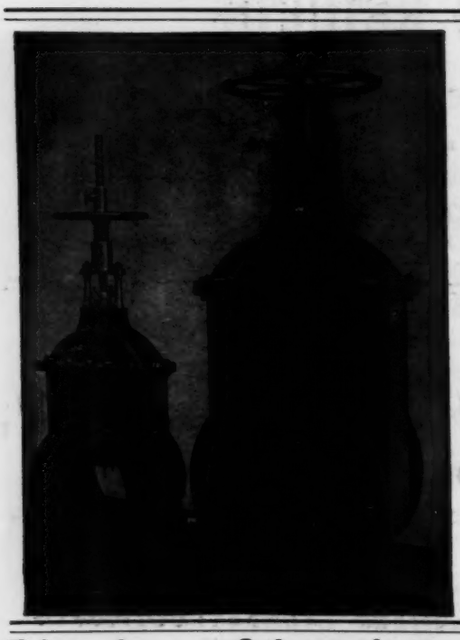

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These valves are provided with double discs or gates, and are tight with the gas pressure on either side of them.

The discs are so arranged as to be free from their seats when being opened or closed, and are operated by a quick-acting mechanism. The valve stem extends outside of the bonnet, and serves as an index, showing whether the valve is closed or open, and the amount of opening. They are made of the following dimensions:

Size.	8 Inches.	10 Inches.	12 Inches.	16 Inches.	20 Inches.	24 Inches	30 Inches.	36 Inches.
Diameter of flanges.....	13 inches.	16 inches.	18 inches	22½ inches.	27 inches.	3 inches.	37½ inches	44 inches.
Face to face of flange...	12 inches.	12 inches.	12 inches	14 inches.	17 inches	20 inches	21 inches.	23½ inches.

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P. O. STATION G.

Directory of American Gas Companies, 1905.

Price, $5.00.

For Sale by

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GASHOLDERS AND STEEL TANKS

OF ANY SIZE AND DESCRIPTION,

And All Ironwork and Apparatus Required in a Gas Plant.

Also Oil Storage Tanks, Steel Roofs, Valves, Etc.

Makers of Apparatus for THE CHOLLAR PROCESS OF GAS PURIFICATION.

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GASHOLDERS, with or without Steel Tanks.

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If you use the Reeves slot attachments on them. Any good make of meter combined with the Reeves attachment makes the most perfect prepay meter ever manufactured.

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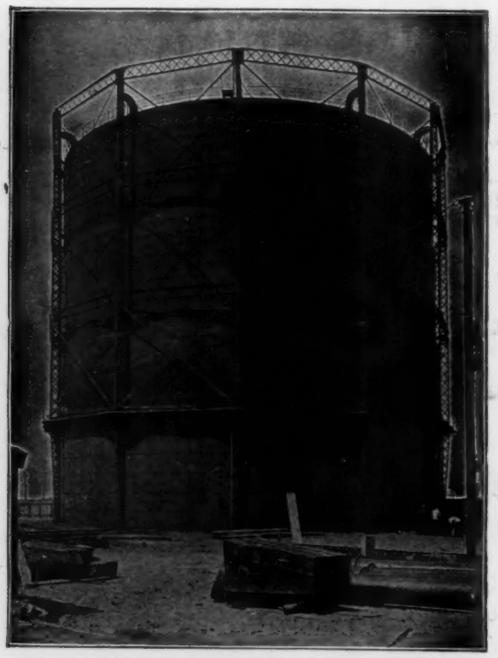

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Single-Lift or Telescopic,

With or Without Steel Tanks.

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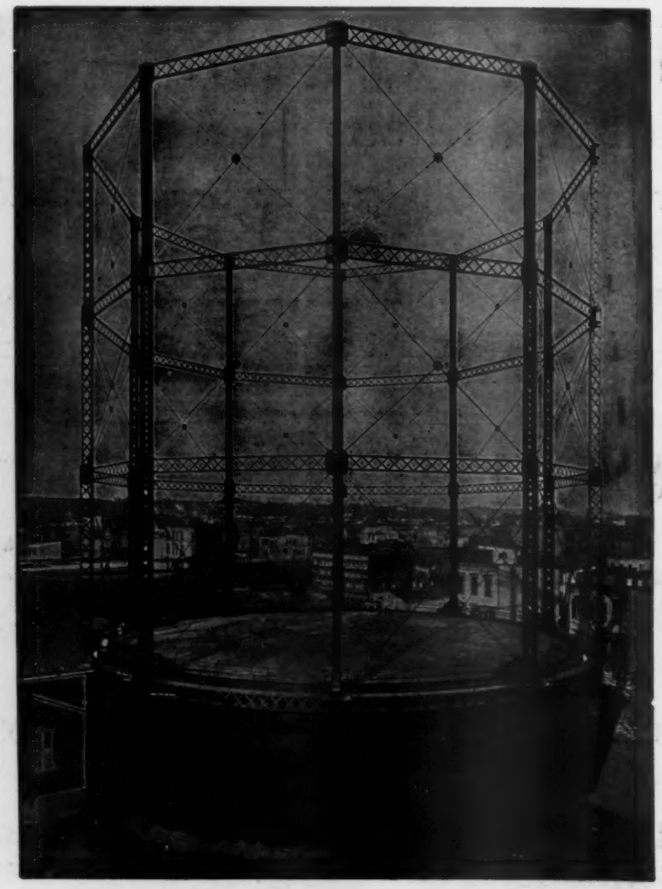

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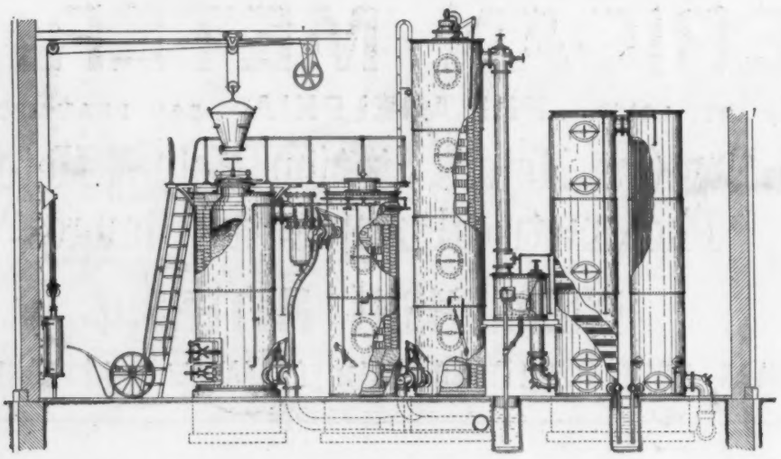

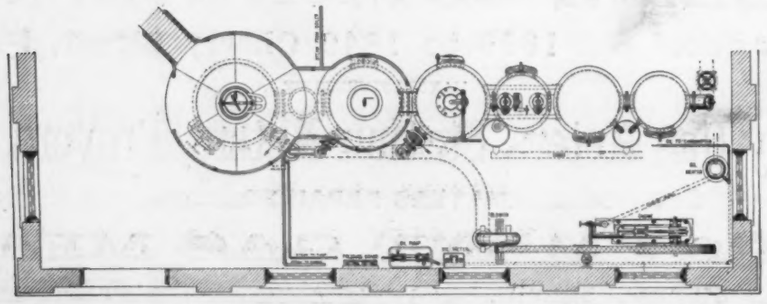

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